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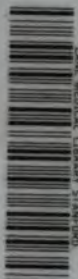
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IMPERATIVE SURGERY



IMPERATIVE SURGERY

FOR

THE GENERAL PRACTITIONER, THE SPECIALIST
AND THE RECENT GRADUATE

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BY

HOWARD LILIENTHAL, M.D.

ATTENDING SURGEON TO MOUNT SINAI HOSPITAL
NEW YORK CITY

*WITH NUMEROUS ORIGINAL ILLUSTRATIONS FROM
PHOTOGRAPHS AND DRAWINGS*



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To

MY INSTRUCTOR, FRIEND, AND COLLEAGUE

ARPAD G. GERSTER, M.D.

This Book is Affectionately Dedicated

PREFACE

THE practitioner of general medicine who rarely takes up the scalpel, the specialist whose path seldom leads him to the operating-room, and the recent graduate who, though versed in the lore of the books and lectures, has seen but little surgery at close range, are those for whom this work has been prepared.

It deals only with the diagnosis and treatment of conditions which demand immediate operative measures, and it presupposes the absence of a surgeon and the impossibility or inexpediency of removing the patient or of waiting for expert assistance. Circumstances under which such a predicament may occur will readily suggest themselves to the reader.

Clearness and simplicity have been striven for in the discussion of pathological states and the selection and description of the operations proposed for their relief. As a rule, but a single good method has been given, so that the reader may not find himself in a dilemma as to the selection of an operation.

The illustrations are nearly all from photographs or drawings made during the progress of actual work in the author's practice. They represent things, as nearly as possible, as they actually are, although the careful and artistic work of the gentlemen who assisted me in their preparation has lent them, in addition, a certain distinctness of representation which, it is believed, will make plain the steps to be illustrated.

Literary references and the names of the originators of operations have been omitted. This has been done purely for the sake of simplicity, and the author has been careful to treat himself in

the same way that he has treated others, avoiding reference by name to any procedure which he may consider original or even any instrument which bears his name.

Since it is presupposed that operations will be performed under conditions not conducive to absolute surgical cleanliness, antiseptic treatment has been especially recommended in addition to the more ideal aseptic method.

A certain amount of repetition has been unavoidable, and will, it is hoped, be forgiven.

My grateful acknowledgments are due to Dr. L. A. S. Bodine, of the House Staff of Mount Sinai Hospital, for the untiring exercise of his artistic skill and technical knowledge in the preparation of most of the photographic plates, many of which were secured under great difficulty and inconvenience.

To Dr. A. G. Foord, House Physician to the Hospital, I also desire to express my thanks, not only for his valuable assistance with the plates, but for the never failing courtesy with which he lent aid in other ways.

The drawings are by Mr. Erwin Reissman of the firm of Havelka and Reissman, from sketches made by him during the progress of the operations. I desire to thank him for his painstaking work.

It is my wish, too, to acknowledge publicly the kindness of Professor Irving S. Haynes and Dr. John Rogers, Jr., in extending to me the facilities of the anatomical laboratory of the Cornell University Medical College.

Finally, I wish to express to the members of the House Staff of Mount Sinai Hospital my appreciation of the cheerful and willing manner in which their aid was uniformly given.

H. L.

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IMPERATIVE SURGERY



IMPERATIVE SURGERY

CHAPTER I

INTRODUCTION. INSTRUMENTS. DRESSINGS. LIGATURES. SUTURES, ETC.

CONFRONTED by a grave emergency, where the life of a human being seems to hang upon the possibility of relief through surgical skill, the conscientious physician, when he feels that he is not sufficiently versed in the art and method of operating, will seek the assistance of an expert. Should time and place conspire, however, to make the presence of a surgeon impossible, the entire responsibility devolves upon the one who may chance to find himself in charge; and unless he is willing to assume the risks of hesitation, he must act the part of the surgeon and perform, to the best of his knowledge and ability, the work before him. Again, should the crisis be one, not of life or death, but where lingering disease or lasting deformity will probably follow delay, it is the clear duty of the physician to act and tide over the critical period. He must press into service such help as may be had and make use of whatever instruments and paraphernalia can be gathered together, often substituting household articles for surgical apparatus and the ordinary dwelling-room for the well-equipped operating theatre. Whatever the surroundings, the key to success is the strict observance of cleanliness, antisepsis, and correct operative method.

Certain instruments will be here enumerated as being desirable possessions. Substitution may be necessary when the proper appliance is not at hand, but makeshifts should be avoided wherever

Selection of Instruments.—Size and convenience in handling are important qualities. A larger instrument should, as a rule, be



FIG. 1. — Medium-sized sharp retractor.

selected in preference to a smaller one. The possibility of sterilization by boiling should be inquired into.

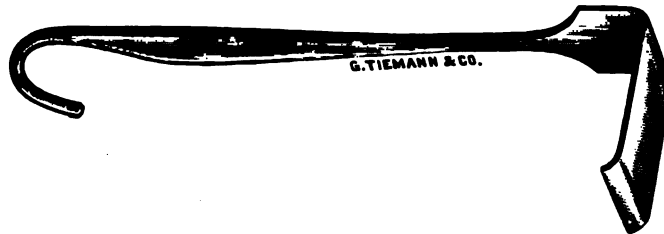


FIG. 2. — Medium-sized blunt retractor. The handle may be used as a blunt hook.

Knives.—Scalpels are of various sizes and shapes. In an emergency a sharp pocket-knife which may be sterilized by boiling in a one per cent. solution of carbonate of soda will answer most requirements.



FIG. 3. — Large blunt retractor.

Scissors, curved and straight, are of various sizes. The ordinary screw-joint is best, as it is not easily put out of order. Proper boiling will render it sterile.

Retractors are sharp and blunt, large, medium-sized and small. (Figs. 1, 2, and 3.) A teaspoon or a tablespoon, the handle bent



FIG. 4.

at right angles to the shaft, makes a good small or large blunt retractor. Still smaller ones may be improvised with the help of a

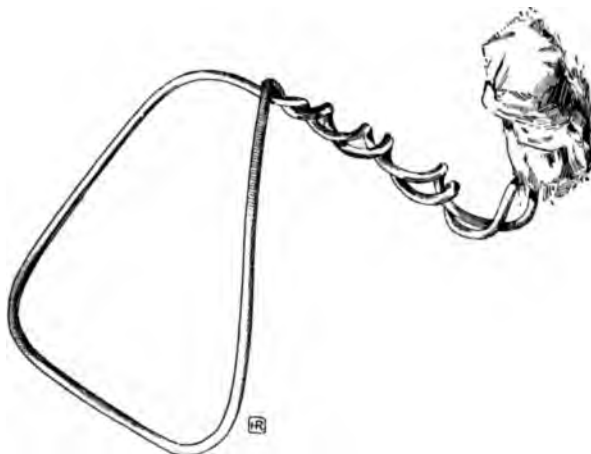


FIG. 5. — Blunt retractor made of wire (improved). Gauze is wound round the sharp ends. Gauze or muslin wound round the blade converts it into a flat blade instead of a ring.

little wire or even with the ubiquitous hairpin. A kitchen fork, the tines bent with a little additional turn near the points (Fig. 4), is an excellent sharp retractor.

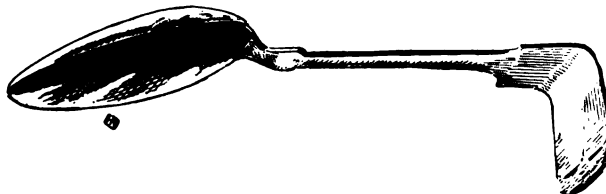


FIG. 6. — Blunt retractor made by bending a spoon.

Probes. — Figure 7 shows how a probe may be constructed from wire, while the opposite extremity of the instrument may be used as a cotton-carrier or applicator.

Artery Forceps should work smoothly and grasp surely. They should be tested by catching the edge of the finger-nail and noting whether increasing pressure

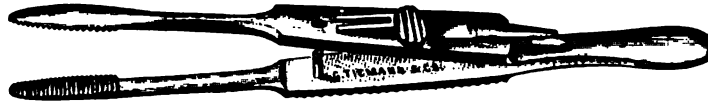


FIG. 8.

upon the shanks of the instrument causes a tightening or a loosening of the grasp. A poor artery forceps will weaken its hold when the shanks are pressed together, while a good one tightens its grip.

Dressing-Forceps should be strongly made and should have no catch.

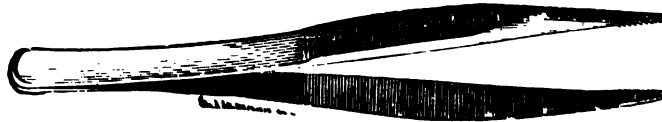


FIG. 9. — Anatomical forceps.

Anatomical or Thumb Forceps should respond to the same test as that for the artery forceps.

Mousetooth Forceps, shown in Fig. 10, are of special use in dissection. The fixation forceps, used in



FIG. 10.

working about the eye, have broad, serrated, grasping edges, and may be locked by a catch. (Fig. 23.)

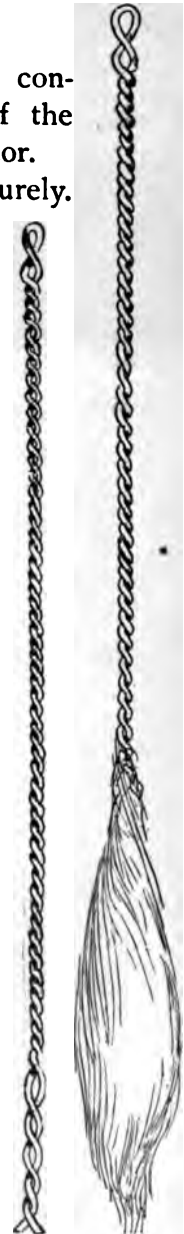


FIG. 7. — Improvised wire probe and applicator.

Alligator Forceps are for extracting objects from deep, narrow cavities. (Fig. 11.)



FIG. 11.

Bullet Forceps. — This is a useful instrument for grasping slippery tissue, such, for example, as the cervix uteri. It is an efficient sponge-holder as well. Of course, its original use is that indicated by its name. (Fig. 12.)

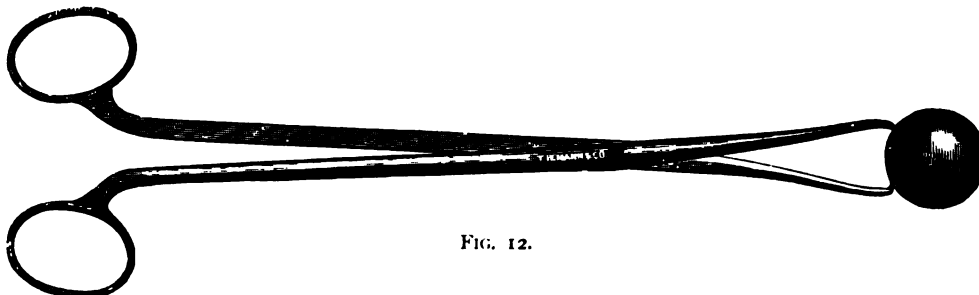


FIG. 12.

Gynecological Dressing-Forceps may be used as sponge-holders. The joint should be nearer the end of the blades than the middle of the shaft.

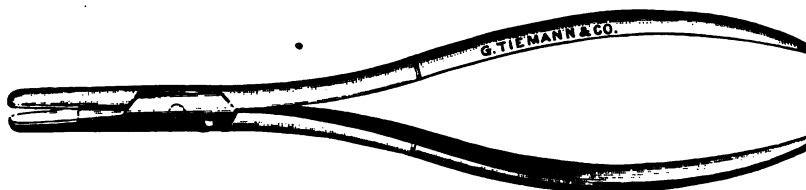


FIG. 13.

Needle-Holder. — These instruments are of many varieties. The simplest is the best. (Fig. 13.) Its jaws are faced with lead or copper so as to avoid slipping. Large needles may be held near the middle of the jaws, while small ones should be grasped near the tip of the instrument so as not to break them.

Needles are of various shapes and sizes. A thin darning-needle can, with some difficulty, be made to do service in suturing the skin when the lance-shaped surgical needle is not to be had. The hemostatic needle has no cutting edge. Its name indicates its principal use.

Sharp Spoon. — There are large and small sharp spoons. (Fig. 14.) The handles should be long enough to permit of the curet-



FIG. 14.

ting of sinuses and other cavities. A fair emergency substitute for this instrument is the spoon-shaped potato-cutter of the kitchen. (Fig. 15.)



FIG. 15.

Trocar and Cannula. — These are of various sizes. The handle should be large enough to afford a comfortable grasp. (Fig. 16.)

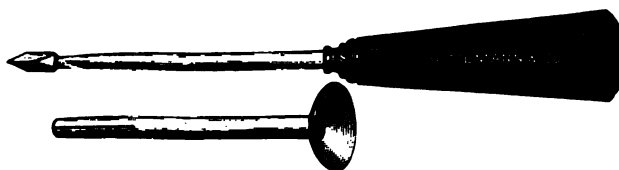


FIG. 16.

Infusion Cannula. — One form of this useful instrument is shown here. (Fig. 17.)



FIG. 17.

Chisels and Gouges for bone work should be convenient to handle. The ordinary carpenter's tools or instruments made upon

the same general plan are the best. A mallet may be procured at the house-furnisher's.



FIG. 18.

Bone-cutting Forceps are shown in Fig. 18. They should be large, by preference, because of the additional advantage of the long leverage.

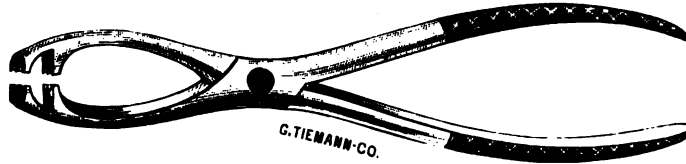


FIG. 19. — Lion forceps.

Lion Forceps may be substituted by the gas-pliers.

Periosteal Elevator (Fig. 20). — In the absence of this instrument the closed blades of a blunt-pointed pair of scissors may be employed.



FIG. 20.

Saws. — These are of various shapes and sizes. A carpenter's or even a butcher's saw will do, provided the more elegant instrument of the surgical cutler cannot be obtained. In operating upon small bones, the ordinary little hand scroll-saw will be found very serviceable. The blades break easily, but may be instantly replaced. The cost of the instrument is but a few cents. The wound made by this saw is a very clean one which heals easily.

The Aspirating Syringe should, for ordinary purposes, hold from half an ounce to an ounce of fluid. There should be an attach-

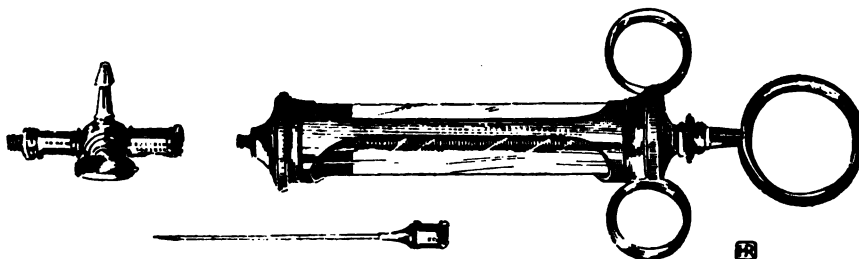


FIG. 21.

ment permitting of the emptying and refilling of the barrel without disturbing the position of the needle in the tissues. (Fig. 21.)

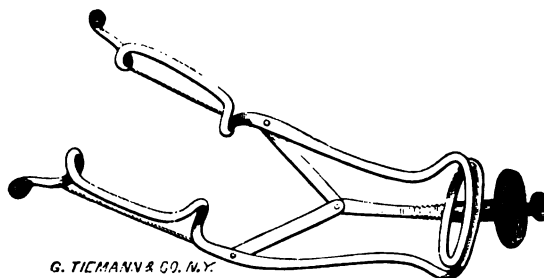


FIG. 22.

The Eye Speculum should be adjustable as to the separation of the retracting parts, and so made that it may be used equally well in either eye. (Fig. 22.)



FIG. 23. — Fixation forceps.

In the absence of a speculum for the examination of the rectum or the vagina, a large tablespoon bent as shown in Fig. 30 may be employed with satisfaction.



FIG. 24.

Blunt and Sharp Uterine Curettes are shown in Figs. 24 and 25.

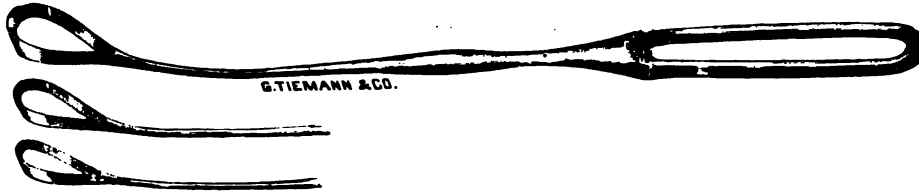


FIG. 25.

The **Depressor** for holding the anterior vaginal wall when the Sims speculum is employed may be improvised by twisting a piece of stiff wire as shown in the illustration. (Fig. 26.)



FIG. 26. — Improvised vaginal depressor. Gauze wound round sharp ends of wire.

Uterine Dilators are of various patterns. A simple form is shown here. (Fig. 27.)

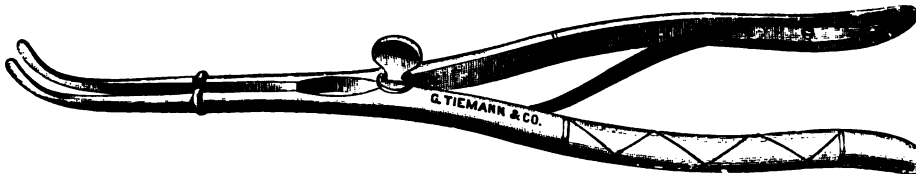


FIG. 27.

The **Gag** to be used during anæsthesia is made of hard wood cut into the form of a blunt wedge and notched at the edges so as

to cause it to keep its position between the teeth. (Fig. 28.) By inserting the gag between the molars the jaws may be quite widely separated. A simple and very efficient mechanical gag is shown in Fig. 29.



FIG. 28.

Dressing Materials.

— Light, sterilizable, absorbent substances are most suitable for

surgical dressings. Of the many materials which have been employed, perhaps the best, all qualities considered, is the gauze or cheese-cloth of the shops, made absorbent by extracting the fat. It may be purchased all ready for use in packets of from one to twenty-five yards from drug firms or from

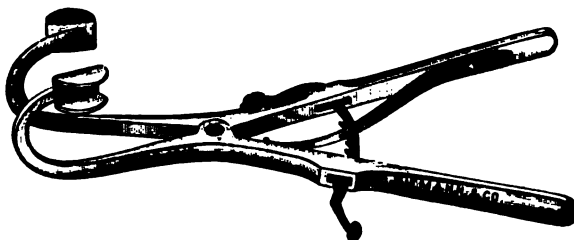


FIG. 29.

houses which make a specialty of surgical supplies. The gauze may be prepared at home by boiling it in a solution of carbonate of soda (washing-soda), in the proportion of one pound to twenty yards of gauze, sufficient water being used to completely cover the material. It should be boiled for half an hour, and then rinsed in several changes of water so as to get rid of the soda. It should afterward be dried and baked in an oven until slightly scorched, and may then be wrapped in a clean sheet until it is to be used. A convenient way to avoid exposing the entire store to the possibility of infection each time that gauze is required is to put it up in packets of from five to ten yards each.



FIG. 30.

In an emergency old linen or cotton cloth, thoroughly boiled, will make a fair substitute for gauze. If a dry dressing is required, the freshly boiled cloth should be wrung out with clean hands and put into the oven to dry and bake. A small piece to cover the wound itself should be well scorched with a hot smoothing-iron. If no cloth is to be had, almost any absorbent substance may be made to answer the purpose; such, for example, as baked saw-dust, grass, leaves, or even earth. If there is but a small quantity of cloth, these substances may be put into bags so that while they absorb the discharges they need not touch the wound itself.

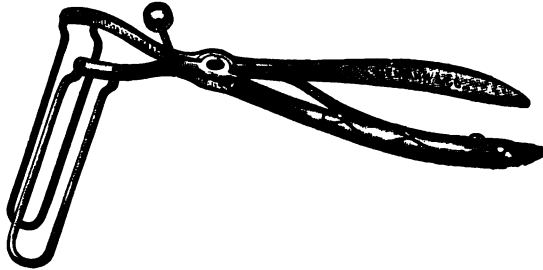


FIG. 31. — Rectal speculum.

Bandages should be made of a rather stouter material than dressing-gauze. The cloth should be torn into strips of from one to six inches in width and rolled firmly into cylinders, or it may be used in large pieces which must be pinned or sewn in place.

Absorbent Cotton is used to fill out dressings, to pad such parts as may be irritated by the rubbing or pressure of the bandage, to take the place of sponges during operations, and for many other purposes.

Common Cotton Batting is preferable wherever elastic pressure is desired.

Rubber Adhesive Plaster is used for a variety of purposes. It is irritating to the skin of certain individuals, and the diachylon plaster may have to be substituted.

Gutta-percha Tissue. — This is of value where we desire to prevent adhesion between the dressing and the wound, or between living tissues, and where an occlusive wet dressing is to be applied. It comes in many qualities, some exceedingly thin, and others as

thick as heavy note-paper. It should not be used near anything hot, such as a poultice, for it will shrivel and become useless. Oiled silk or one of its substitutes must then take its place. Oiled paper makes an efficient covering for a wet dressing and, in the absence of this, a piece of newspaper or brown paper may be well rubbed with vaseline, lard, butter, or any ordinary fat, and it will be found to answer the purpose quite satisfactorily.

Dry Dressings consist merely of the gauze placed next to the wound and not covered by a sheet of impervious substance.

Wet Dressings are soaked with some fluid and covered with waterproof material. They promote drainage and macerate the wound and the skin. The solutions used in wet dressings should be non-irritating, whether they are antiseptic or not. One of the best liquids for this purpose is the solution of the acetate of aluminium. It may be made according to the following formula:—

Lead acetate crystals	.	.	.	.	.	.	.	.	28 parts.
Alum	.	.	.	.	.	.	.	.	70 parts.
Water	.	.	.	.	.	.	.	.	800 parts.

Mix and filter well. Dilute, when to be used, with three to five parts of water.

In the absence of the necessary chemicals to make this solution, common salt, six parts to a thousand of water, and the liquid thoroughly boiled, may be used. It is bland and sterile, not irritating the most delicate tissues of the body.

Oily Dressings. — Vaseline, castor-oil, benzoated lard, lanolin, and a variety of other fats, are used as wound dressings. A ten per cent. solution of balsam of Peru in castor-oil is one of the best of this class. The fatty substance should be thickly spread upon a piece of gauze, applied to the wound and bandaged in place.

Antiseptic Chemical Solutions. — Carbolic acid (phenol) is used in ninety-five per cent. solution with glycerin as a powerful disinfectant and escharotic. In this strength it must be employed with the greatest caution. The antidote to the carbolic, so far

as its local effects are concerned, is strong alcohol. Three per cent. carbolic acid in watery solution is useful as a fluid for the immersion of instruments during an operation, but it should not be invariably employed. Exceptions will be noted in the chapters on regional surgery.

Bichloride of Mercury in strengths of from one per cent. to one-tenth per cent. are disinfecting lotions.

Lysol is a soapy liquid which has an odor similar to that of carbolic acid, but is less poisonous and irritating. Its watery solution rapidly becomes milky in appearance. It may be used in strengths of from one-half per cent. to one per cent.

Orthoform is a somewhat antiseptic, slightly soluble powder. When brought in contact with nerve endings, it acts as a powerful and lasting local anæsthetic. It will be referred to in following chapters. Orthoform acts, in some cases, as a local irritant and, in individuals who are susceptible, it may start an eczema. The continued use of the drug is, therefore, contraindicated.

Catgut. — This may be purchased all ready for use, sterilized in the containers. If it should be desired to prepare it at home, the gut should be immersed in ether for twenty-four hours, shaking the vessel occasionally and changing the ether when it becomes turbid. It should then be taken out of the ether and put in one per cent. alcoholic solution of the bichloride of mercury, whence, after another twenty-four hours, it is put in strong alcohol and kept, thus immersed, until used. It is best to prepare the catgut in lengths of from two to five yards each, wound upon little spools or reels, each in a separate bottle. If any catgut is left upon a reel which was partly emptied at an operation, it should be thrown away and not resterilized. The reels and bottles should be thoroughly boiled for at least an hour.

Good aseptic catgut, of the average size for sutures, is absorbed in a healthy wound in about five days. If it is desirable that the gut should resist absorption for a longer time, it should be chromicized.

Chromicized Catgut. — Ordinary catgut is put in strong alcohol for twenty-four hours, then rolled upon reels and placed in a solution of the bichromate of potash in five per cent. carbolic acid, thirty grains to the quart. Here it should remain for forty-eight hours, when it may be transferred to alcohol and kept immersed until required.

Silk may be perfectly sterilized by boiling it in five per cent. carbolic for five minutes. It is kept in alcohol like the catgut.

Cotton Thread may, in an emergency, take the place of silk or catgut for any of the purposes to which a ligature or suture is put. It should be sterilized like the silk, but if there is no carbolic, boiling for half an hour in plain water will suffice.

Silkworm Gut may be purchased from dealers in fishing-tackle. It is sterilized by boiling it in five per cent. carbolic, and should be preserved in the same solution until required.

Sponges. — Small reef sponges are purchased by the pound. They should be put in a bag and thoroughly beaten with a large mallet to rid them of the gross dirt. Then they are to be soaked in eight per cent. crude muriatic acid for twelve hours or longer to dissolve out the lime salts. For twenty-four hours they should then be put in running water, after which they are to be kneaded and washed in five per cent. solution of green soap (*sapo viridis*). After another twenty-four hours in running water the sponges are to be placed in five per cent. aqueous solution of carbolic acid, where they remain until needed. This somewhat troublesome process is absolutely necessary if the sponges are to be depended upon as sterile. When it has once been used in an operation, no sponge should ever be used again for a similar purpose, no matter how carefully it has been resterilized.

Substitutes for Sponges. — Pads of several thicknesses of gauze, folded and caught with a stitch or two, will, in most cases, act fairly well in the place of sponges. Sterility is more certain, and this, in great measure, makes up for the absence of the sponge-like elasticity and absorbing power.

Splints and Other Rigid Dressings.—Thin boards of some light wood well padded with cotton or gauze make useful splints. Strips of basswood veneering, which may be obtained of the box-manufacturers, or thick pasteboard *torn* into the proper form and moistened with water, may be incorporated in the dressing as the bandage is applied, and they add so much to its rigidity as to form practically a splint. Crinoline (see next subject) is the bandage material best suited to this form of stiff dressing, but since it dries and hardens slowly, these splints are unsuitable for the fixation of fractures where there may be a strong tendency to recurrence of the deformity.

Sheet tin in strips about half an inch wide and as long as the case demands are excellent for stiffening a dressing. The strips should be perforated by means of a pointed nail or an awl, driven through with a hammer in a series of holes about two inches apart, and then a second series should be made between the first holes, the tin being reversed so that the perforating tool shall pass through in the opposite direction. Rough elevations will thus be formed on each face of the strip, upon which the bandage will catch, holding the tin in place.

Crinoline.—A convenient material to be used in the formation of rigid dressings is a kind of crinoline or stiff gauze which may be obtained from dealers in dry goods. It is known to the trade as “supers,” and depends for its peculiar quality upon a finishing of starch, dextrine, or a combination of both. Roller bandages of this cloth should be immersed and kneaded for a few moments in warm water, so as to thoroughly saturate them. They are then ready for use. The goods are of different degrees of stiffness. In about two hours the bandage has set, forming a light and very rigid splint. It is easily removed either by cutting it away with a knife or by soaking it for a short time in water, after which it may be unrolled. To make a particularly stiff splint of this sort, a few tin or veneering strips should be incorporated and from four to six layers of the crinoline should be applied.

Plaster of Paris, from its great rigidity and the rapidity with which it sets, is, perhaps, the most satisfactory of all the materials commonly used for making splints. The best dental plaster should be employed whenever it is available. It should be rubbed into the mesh of a strip of gauze or crinoline, which is then rolled into a bandage and kept in a tin box; or each bandage may be wrapped in a separate piece of paper, so that the plaster shall remain comparatively unacted upon by the atmospheric moisture. Having padded the part to be bandaged, or thickly anointed it with vas-



FIG. 32.—Unfinished rigid dressing, showing incorporation of strips of thin wood (veneering).

eline, a single roll of the plaster bandage should be submerged in tepid water, the roll standing on end until no more bubbles rise, when, after a light kneading, it should be quickly applied as an ordinary roller, a second plaster bandage being immersed during the application of the first. From three to six layers should be used, incorporating thin pieces of wood or tin strips if special stiffness is desired. When the dressing is in place, and while it is in process of setting, gentle friction with the hands will make the surface smooth. Good plaster which has not been exposed to moisture before using should harden in a few minutes. If speed is desired at the expense of hardness, salt may be added to the water in which the bandages are to be soaked in the proportion of one teaspoonful to each two quarts.

A plaster of Paris splint may be removed by cutting it through with a sharp knife. The various saws and other appliances which are intended to make this work easy are either clumsy or expensive.

When using the knife, the thinnest portion of the splint should be selected, and the incision should not be perpendicular to the surface, but as nearly parallel with it as will permit of the effective use of the knife. As each layer is incised, it should be pried up with a blunt instrument and the next layer attacked. The work of removing even a thick splint is not very laborious if performed in this manner.

CHAPTER II

WOUNDS AND THEIR TREATMENT

Sepsis, Asepsis, and Antisepsis. — The condition of sepsis, so far as wounds are concerned, implies the presence of pathogenic germs or their toxins. Asepsis means not only that the wound is surgically clean and free from toxins, but that the germs which might cause infection are absent. Antisepsis relates to measures by which the germs, when present, are to be destroyed directly or indirectly. When the germs or their poisonous products have entered the circulating media of the body, there arise certain signs and symptoms which indicate that the entire system has become influenced, and that we are dealing with what is known as general sepsis of a greater or lesser degree. It is a theoretical fact, however, that whenever local sepsis is present there is always some absorption, and, therefore, some general poisoning, though this may be so slight that it may sometimes be disregarded. Since there is no known method for ascertaining just when a local sepsis is about to pass into the more serious constitutional form, it is the part of wisdom to prevent, if we can, the occurrence of the contamination, and to stamp out the danger as soon as possible after its presence is recognized.

Wounds and their Treatment. — The treatment of wounds must vary according to their physical character, a puncture often demanding different treatment from an incision or a laceration, while there may be further variations according to the known or suspected presence or absence of septic infection. The kind of tissue involved has also much to do with the selection of the proper

method of treatment; wounds of bone, for example, requiring different therapeutic measures from injuries to muscle.

Punctures. — Punctured wounds, if made with a clean, sharp-pointed instrument through a thoroughly clean portion of the surface of the body and not involving important organs, require no especial treatment except that which is intended to preserve the existing condition of cleanliness. Surgical cleanliness, which is here implied, is only met with when the puncture itself was an operative procedure. The application of an aseptic, absorbent, non-irritating dry substance is usually sufficient to insure prompt healing under the first dressing. A piece of sterile gauze held in position by a bit of adhesive plaster or a bandage may be left undisturbed for two or three days and then removed, when the punctured wound will be found covered with a little crust of dried serum. It will require no further attention. If the puncture has been made with a rather large instrument, or one which is somewhat blunt, the dressing should be undisturbed for four or five days, and if the wound is not perfectly dry at the time of the first change, the puncture and its neighborhood should be carefully wiped with dry sterile gauze or cotton, and covered with a dressing like the first. In all manipulation about even the most trivial wound, the greatest care should be taken that nothing undisinfected may come in contact with it; and the same caution should be observed every time the site of the injury is exposed. This is of special importance when we are dealing with wounds known to be clean. Directions for disinfecting the hands of the surgeon, his instruments, and the field of operation will be found in the following chapter.

When a dressing or other manipulation happens to be of a very unimportant nature, requiring only one or two instruments, such as forceps and scissors, it is often very inconvenient to be obliged to go through the boiling process of sterilization. As an efficient substitute it is only necessary to hold the instruments in a flame for a moment and then to plunge them into clean water. The

hissing which ensues shows that a sufficient degree of heat was attained. The flame of a little piece of cotton soaked in alcohol or even the flame of a match will suffice to render surgically clean those parts of the instruments which come in direct or indirect contact with the wound. The hands of the surgeon should, however, be just as carefully disinfected for a dressing as for an operation.

If we are aware that the puncture was made with an instrument not surgically clean, or if the skin of the patient was known to be clean in the usual sense but not disinfected, it will be found safer to apply a soaking wet dressing covered with oiled silk, oiled paper, or some other material impervious to water. For the soaking lotion the acetate of aluminium solution is to be preferred, or, in its absence, a one-sixth per cent. saline solution may be used. Without indication for earlier interference, the dressing should be changed and the wound inspected in twenty-four hours. Progressively increasing pain or the appearance of constitutional symptoms make it necessary to examine the wound sooner. Tenderness, redness, or œdema indicate infection, and the case should be dealt with after the manner described in Chapters V. and VI.

Punctured wounds made with dirty instruments, or through tissues or coverings known to be unclean, should be treated as local infections. After a thorough scrubbing and washing of the wound and the neighboring parts an incision large enough to permit the introduction of a narrow slip of gauze should be made through the tissues at the site of the puncture and as deep as the puncturing instrument went. The depth of the puncture may be learned by inspecting the incision while its edges are held apart with sharp retractors. The length of the incision must be determined by the depth of the wound and the tissues invaded. (See chapters on Regional Surgery for exceptions to this rule.) The gauze packing should be covered with a wet dressing, which must be changed in twenty-four hours or less.

When made under circumstances which render infection inevitable, punctured wounds improperly treated give rise to the sever-

est forms of sepsis. The tiny prick of the needle in the surgeon's finger during the performance of a "septic" operation has cost many a life which could ill be spared from the ranks of the medical profession. Such apparently trivial wounds should be at once enlarged by a small incision and either covered with a little wet dressing or cauterized with glacial acetic acid.

Incisions. — Incised wounds, when they are made by the surgeon as one of the steps of a clean operation, may be regarded as thoroughly aseptic until they are proven to be otherwise. They should be closed by sutures, the material of which should be preferably silk, and covered with a dry aseptic dressing which, in the absence of tension or infection, may be left in place for four or five days. They should then be removed and the dressing renewed. As a general rule it may be stated that whenever there exists a space due to the removal of tissue, the dressing should be an elastic one, such as a mass of loose gauze, and the bandage should be firm enough to obliterate the space so that its walls may adhere. If such so-called "dead spaces" are left uncared for, they become filled with serum or blood coagulum and form favorable points of attack for microbes. If the space is a considerable one, as when a large lipoma has been removed, several layers of sutures may be employed to hold the walls of the cavity in contact, and if it is difficult or impossible to manage this, the wound should be drained. (See Chapter IV.)

Accidental incised wounds should, as a rule, be regarded with suspicion as to their asepsis. The first thing to do is to check hemorrhage (Chapter IV.), and then efforts at disinfecting the wound itself and the surrounding surface should be zealously made. This is all the more important when, from the character of the injury and the instrument which caused it, there is probability that complete asepsis may by these efforts be attained. In dealing with injuries of the face or other exposed parts, it is, moreover, particularly desirable to avoid, if we can, the necessity for prolonged treatment as well as the more obtrusive scar which follows

healing by granulation. The wound may be scrubbed with a stiff, clean brush, or scraped with a sharp spoon or the blade of a scalpel, and then it should be thoroughly washed with some disinfecting fluid, such as 1-1000 bichloride. An incision which has been thus cleansed may be sutured with silk, the stitches being placed rather far apart. It should be covered with a moist dressing. The advisability of drainage will depend upon the probability of infection in spite of our precautions. A fillet of gauze will in most cases act efficiently, though if there is a rather large cavity which may be expected to discharge freely, a tube may be employed.

If the incision is undoubtedly contaminated, as when the vulnerating instrument or the skin of the patient is known to have been very dirty, there should be no suture, no matter how carefully we may have attempted disinfection. Such wounds should be packed with gauze and covered with a wet dressing, attempts at closure being postponed until the danger is past. It is frequently the wiser course to allow the wound to heal entirely by granulation, and if it is then desired to do away with the too massive cicatrix, an operation for its excision may be performed later.

Lacerations. — Lacerated wounds, being usually the result of accident, are seldom aseptic, and should never be regarded as such when they are first seen. Having checked hemorrhage, disinfection should be attempted, as in the case of incised wounds, by scrubbing, scraping, and washing with antiseptic solutions. The flaps of the wound should be studied in order to learn where each anatomically belongs. This is not always an easy matter, especially where the laceration is a complicated one and the tissues are lax, as is the case with the skin covering the scrotum and penis. When the proper relations of the flaps have been determined, the skin may be held in position by sutures, the necessity for drainage always being considered. The edges of the skin are apt to curl under, and therefore special pains must be taken to keep them everted until each suture is tied; otherwise, the adaptation will

be rough and the resulting scar ragged (Fig. 33). Great care must be exercised that no flap shall be devitalized because of the cutting off of the circulation by improperly placed sutures. This is most apt to occur when the attempt is made to fasten an angular flap in position by two sutures drawing in opposite directions. (Fig. 34.) If a flap seems pale at its edge, sloughing will probably take place, and such flaps should not be sewn at all, unless, indeed,

it is possible to retain them by sutures which take hold far from the edge.

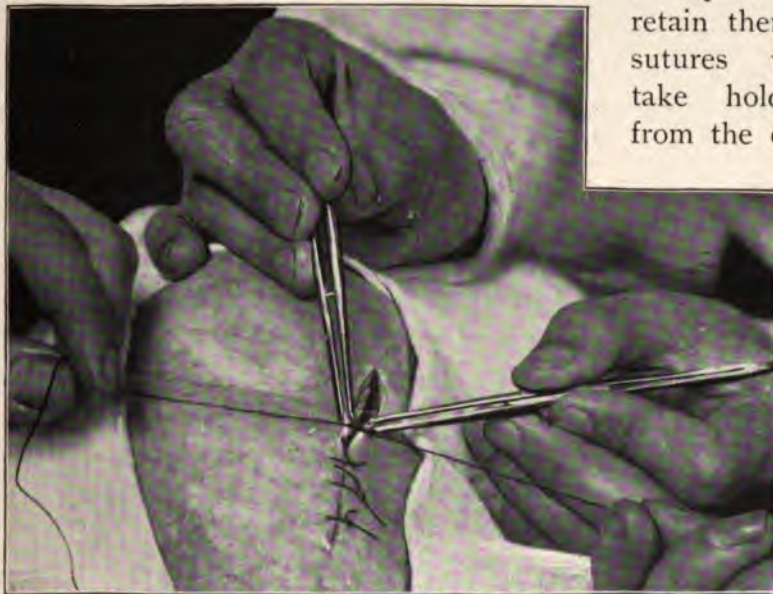


FIG. 33.—Everting the lips of the wound during suture.

The safest covering for injuries of this sort is the wet dressing, and, because of the danger of necrosis, the bandage must not be too firmly applied. The wound should be dressed in from twenty-four to forty-eight hours, when, if there has been no pain and no fever, or other sign of systemic disturbance, and if there are no signs of local irritation, a dry dressing may be substituted. If there has been pain, and the wound, or any part of it, looks swollen or red, and if the pulse, temperature, and general condition of the

patient make the presence of septic infection probable, the sutures must be removed, the wound thoroughly reopened, washed out, packed, and dressed wet. It is sometimes permissible, when a mild infection seems limited to one part of the wound, to leave the sutures in the uninfected portions, especially when we are treating injuries of the face; for here, more particularly if the patient is a woman, we are justified in taking a little additional risk with the hope of minimizing the cicatricial deformity.

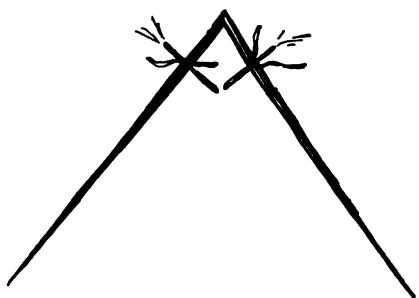


FIG. 34. — Wrong way to suture angular flap. The circulation of the tip will be cut off.

That portion of the wound which has been reopened must be packed with a fillet of gauze. If orthoform can be obtained, it will be found to act as an antiseptic and an efficient analgesic. It should be dusted into the wound, and the usual packing with the wet dressing applied. The orthoform decomposes and, with the wound secretions, may cause a brown discoloration of the dressings. (For further treatment see Chapter V.)

Contusions. — These do not often require operative treatment. There is usually considerable swelling at the site of the injury, caused by the formation of a hematoma. This effusion generally coagulates, and is slowly absorbed, but it may liquefy with or without the formation of pus. Infection may enter by some minute laceration or abrasion. When a hema-

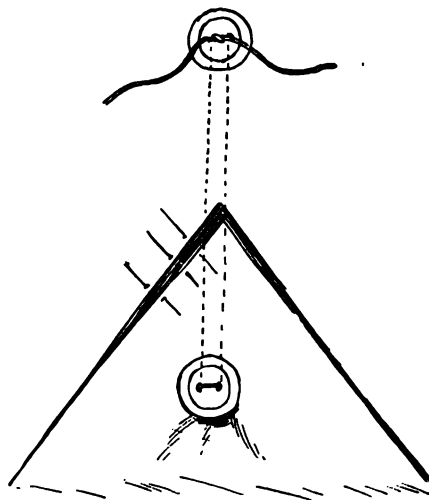


FIG. 35. — Right way to suture angular flap. The button suture holds the flap in position while smaller threads make adaptation.

toma is very painful and tender five or six days after the injury, the effusion should be removed by aspiration or by evacuation through an incision. Puncture and aspiration may be tried first, and if it seems that the contents of the mass are too solid to be removed in this way, recourse must be had to incision. In all operations about a hematoma the preservation of perfect asepsis is imperative. Infection is prone to occur, and this means at least that recovery will be retarded for many days.

Incision of a Hematoma. — It is not necessary to employ general anæsthesia for this little operation, the injection of a drop or two of a eucaine or cocaine solution by means of a thoroughly sterilized syringe being all-sufficient. (Chapters III. and IV.) If one cannot be absolutely sure that the hypodermic syringe is sterile, it is best to make the incision without anæsthesia. The opening should be made where the skin is thinnest over the tumor, by an incision not more than one-third of an inch in length, and the knife should be carried only far enough to actually enter the hematoma. Careful and gentle massage over the mass, always toward the little opening, will gradually force out all the fluid and most or all of the remaining solid clot. It is important that in making this massage the pressure should not be relaxed, for otherwise the walls of the hematoma might separate, and air, possibly containing germs, be drawn into the cavity. The pressure should not be relaxed until the orifice has been covered with aseptic dressing material. A firm and elastic pad of gauze, large enough to extend well beyond the confines of the cavity, should now be held firmly in place by a bandage, so that the walls may be in contact and may remain so during the healing process. In order that the pressure may be equable, it is well to pad thickly the entire part enveloped by the bandage. For that part of the padding not in contact with the wound or its immediate neighborhood common cotton batting will be found more serviceable than the less elastic absorbent gauze or cotton. If in spite of all precautions suppuration should occur, the case becomes one of abscess or phlegmon, and should be treated accordingly. (Chapter VI.)

Foreign Bodies in the Tissues. — Foreign bodies embedded in the tissues may become encysted if they are aseptic at the time of their entrance, or they may, through infection, cause suppuration and the formation of abscess or phlegmon. If it is known that a foreign body has passed under the skin and remained there, causing little or no pain, the question for immediate attention is not so much whether the body is actually present as whether, if present, it may do harm on account of the locality involved. If, for example, a woman comes to us with the statement that a needle has broken off in her hand, it would be unwise for us to make attempts to extract it unless it could be distinctly felt on palpation; while if a boy should present himself with a wound in his rectum and a history of his having fallen in the sitting position upon the end of a stick which had broken off in his tissues, it would be equally wrong to delay operative intervention. The needle, in the first instance, can do little or no immediate harm, while the piece of wood, in the second case, is very liable to give rise to the most disastrous consequences.

If the presence of a foreign body causes severe pain, or by reason of its location threatens immediate harm to the patient, it should be removed as soon as possible. The operation must vary considerably, according to the region involved, so the following method of procedure may require modification in special instances.

It is not often necessary to employ general anæsthesia, cocaine or eucaïne being usually quite sufficient to render the manipulations fairly painless. When possible, it is best to make use of elastic constriction, so that the field of operation may be unobscured by hemorrhage. (See Chapter IV.) The incision should be made at an angle with the supposed direction of the long axis of the foreign body, not parallel with it. The wound should be held open by an assistant with the help of retractors, and these should be made to separate the tissues deeper and deeper as the dissection proceeds, so that at all times the deepest portion of the wound may be clearly inspected by the operator. When it is supposed that the neighbor-

hood of the foreign body has been reached, the carefully disinfected finger should be used if it has not been possible to detect the object by inspection. In palpation of this kind it is not advisable to depend on any information which may be imparted through the use of the finger-nail, for the resistance of bits of fascia or tense fibrous bands of any kind often simulate very closely the feel of certain foreign bodies such as needles or thin bits of bone or wood. The volar surface of the finger will convey the most reliable sensation. Having discovered the body we have been seeking, it may be withdrawn with forceps and the entire wound treated as a laceration where infection may be supposed to be present. The wound may be partly sutured, but it must be drained, and a wet dressing applied. Before dressing the wound, the point of entrance of the foreign body should be carefully inspected, and if the opening was very small, it had better be treated as a puncture of the kind not known to be clean.

Compound Fractures. — When a broken bone communicates with a wound of the skin or mucous membrane, the fracture is said to be compound. Fractures of this variety are naturally far more liable to infection than others, for the reason that the skin and mucous membranes are, practically, never sterile in the surgical sense, no matter how clean they may be in the everyday acceptance of the word. The treatment of these injuries should be directed first to the exclusion of infection, and second to the restoration of function.

Treatment. — As a general rule any small piece of bone which protrudes through the skin should rather be removed with forceps or with the saw than returned to its normal position, even after very careful disinfection. It is prudent to leave the spicule exposed until the surrounding skin has been disinfected, and then to extrude a little more and cut it off. Even this precaution should not, however, assure one that what is left within is aseptic, for it is quite possible that a longer piece was originally pushed through the skin and that a portion has been drawn back again before the surgeon's

arrival. If a very large or important part of the bone is exposed to the air, it should be cleansed as thoroughly as possible by scrubbing with a sterilized, stiff-bristled brush, and then washed with a three per cent. carbolic solution or a 1-2000 sublimate lotion, the antiseptic liquid being afterward rinsed off with sterilized normal saline fluid (six-tenths per cent.). The opening in the skin should then be enlarged by incision and the fracture reduced. If there is



FIG. 36. — Compound fracture of the tibia from a kick by a horse. Comminuted and contused bone has been removed from the lower portion and is being removed from the upper. The gouge will leave a smooth surface of healthy bone.

hemorrhage of an alarming type, a rubber constrictor or a piece of bandage should be wound tightly round the limb above the injury, and the opening should be enlarged so that its edges may be drawn aside with retractors and the interior of the wound carefully examined. After sponging away the clots, the part between the ligature and the wound may be "milked" toward the opening, so that the source of the hemorrhage may be disclosed by the appearance of droplets of dark blood at the mouths of the wounded vessels, which may then be

secured with artery forceps. If there is comminution of the bone, such fragments as are completely detached may be removed, but others should be put into the best position possible and allowed to remain. A tube or a gauze drain should be carried down to the bottom of the wound, and if the laceration is so extensive that it involves nearly the entire thickness of the limb, the drain may even be carried out of a counter-opening at the other side. (Fig. 37.) Small moist dressings of acetate of aluminium solution should be



FIG. 37.—Same case as Fig. 36. The dressing forceps has just drawn the drainage tube into the main wound through the counter opening.

placed over each opening, and the limb then enveloped in a thick and elastic antiseptic dressing bandaged firmly in place with a light plaster of Paris splint over all for purposes of fixation. Whether the wound is practically aseptic or not, some elevation of the temperature and acceleration of the pulse will probably occur within the following twenty-four hours; but unless there are distinct signs of septic infection, the dressings should remain in position for two or three days. If suppuration occurs, the wound must be dressed wet every day, or even oftener, the case becoming practically one of

osteo-myelitis. (See Chapter VI.) (For compound fractures of special bones, see Chapters VII., IX., and X.)

Gunshot Wounds. — Wounds made by the discharge of fire-arms form this class of injuries. They vary somewhat according to the projectile, the type of arm, the kind of explosive employed, and the distance of the injured person from the weapon at the time of its discharge.

Blank Cartridge Injuries. — These are always at close range, the injury consisting of burns and lacerations with often the presence of a foreign body, the wad, in the tissues. The wound is almost invariably infected, so it may as well be treated as such from the beginning. The patient should be anæsthetized, and the wound thoroughly examined, hemorrhage checked, shreds of burned tissue cut away, and the foreign body or bodies sought and removed. No sutures should be employed, and the laceration should be packed with gauze and dressed wet. The danger of tetanus is ever present in wounds of this character, so all disinfection should be particularly thorough. If there is the slightest doubt as to the sufficiency of the drainage, deep incisions into healthy tissue should be made, the wound being dressed as above described.

Sometimes grains of partly burned black powder, driven into the skin, make unsightly tattoo-like marks. These may be removed, if the patient is seen soon after the injury, by thoroughly scrubbing the skin with a very stiff sterilized brush, the patient having been previously anæsthetized. After healing has taken place, it is extremely difficult to remove the marks.

Shot-gun Injuries. — At close range these consist of frightful burns and lacerations which frequently cause death in a short time from shock and hemorrhage. However, as is the case in most gunshot injuries, the individual experiences little or no pain at the time the wound is inflicted. If he was far enough away from the muzzle to allow the charge to scatter, the injury will not be so severe, and it will vary directly with the distance and with the size of the pellets. The treatment will be in general that of a laceration where infec-

tion is suspected, complicated by the presence of foreign bodies. The shot need not necessarily be removed, unless they are just beneath the skin, or are causing mischief by their mere presence. Bits of clothing or other material which may have been carried in by them should be removed if they can be easily found. (See chapters on Regional Surgery.)

Wounds made by Rifle Bullets.—The projectiles in use with rifled arms are of various calibers. They are made of lead or of a lead core with a coating or a partial coating of some harder metal or alloy. All have a rotary or spinning motion about their long axes until they become spent or strike an object. When they are nearing the end of their flight, they wobble like a top which is nearly through spinning, and since they still have considerable penetrating power, the wounds of entrance made at this stage of their flight are often irregular in shape. The wound of exit, where the projectile has perforated, is always larger and more irregular than that of entrance, and sometimes when a bullet has broken in its progress through the body, there may be two or even more wounds of exit. The amount of damage done by a rifle bullet depends on its composition, its size and shape, the force of its rotary motion, and its velocity at the time of impact. There are certain cardinal differences in the character of the wounds inflicted with the older arms using lead bullets and black powder, and those which are caused by the more modern weapons with steel-jacketed bullets and highly explosive, smokeless powder. Without entering too much into detail, it may be said that the bullets fired from the older rifles inflict comparatively ragged wounds, that bits of clothing are liable to be carried in with the projectile, and that the course of the projectile is apt to be rather erratic unless only soft tissues are encountered in its passage. If a bone is struck, the bullet may be deflected so that it takes a course which cannot be known from examination of the wound of entrance and, indeed, sometimes not even from the wound of exit as well. Bullets have even been known to travel half-way round the body, keeping just beneath the skin. Bones

are fractured, and not infrequently parts of the bullet remain behind to cause suppuration, or to become encysted. Blood-vessels may be cut or may be pushed aside.

A bullet of this kind, on meeting with bone, becomes distorted into irregular forms, sometimes having sharp edges, so that for the remainder of its progress it causes severe lacerations. Suppuration is common.

Wounds which are made by the small-caliber, steel-jacketed projectiles show the widest differences in character, according to their velocity at the time of impact. These bullets retain their form, and at the usual distances where the older projectiles would lacerate the tissues they make clean perforations. They may fracture and comminute a bone, but no portion of the projectile is apt to remain in the body. Wounds of joints inflicted with the older rifles are apt to require amputation or resection, while joints may be perforated by the steel-jacketed bullets without subsequent loss of function, both because of the small, puncture-like character of the wound, and also because, for some reason, these wounds seem to be more apt to be aseptic than are the wounds of the larger and slower-going lead bullet. Arteries struck by the steel bullets are not turned aside, but are cut. To make a comparison, one might say that the older bullets caused lacerated wounds, and the newer ones punctured wounds. When the skull is struck by one of the modern bullets, it may be perforated with little damage, or it may be frightfully comminuted so that it seems as if an explosion had taken place from within.

The so-called soft-nosed bullets where the hard metal jacket does not extend to the tip of the projectile, but leaves a portion of the leaden core exposed, are not generally used in warfare, though they are employed in sport against big game. On impact these bullets become of a mushroom shape from the spreading of the exposed soft end. They cause frightful lacerations.

Treatment of Gunshot Injuries.— The first step must be to check any hemorrhage which may be going on, incising the tissues freely,

ELECTRIC BULLET-PROBE

if necessary, and exposing the bleeding vessels. In the mean time the shock, which is an accompaniment of all serious gunshot injuries, may need attention. The wound itself should be treated as a lacerated one, or, if the bone has been injured, as a compound fracture. Gunshot wounds of various regions will be spoken of farther on. (Chapters on Regional Surgery.) If the ball, or a piece of it, is known to be lodged in the tissues, the question of its removal will have to be decided after taking into consideration its location and the probability of its causing future trouble if left where it is. The punctured wounds of the small-caliber, hard-cased bullets need little or no treatment excepting the dressings, unless some important structure has been lacerated. It has been found that the less these wounds are handled, the more quickly and kindly they heal.

In probing gunshot wounds, where it is deemed wise to remove the bullet, it is not always easy to determine whether the probe is in contact with a metallic body or a bit of bone. An electric probe may be very simply improvised in the following manner. (Fig. 38.) Take two pieces of copper wire of suitable thickness, each about two feet in length, and sterilize them by passing them through the flame. Insulate one of the wires by wrapping it neatly with adhesive plaster for about eight inches, leaving a half-inch of bright wire at the end. Now twist the insulated

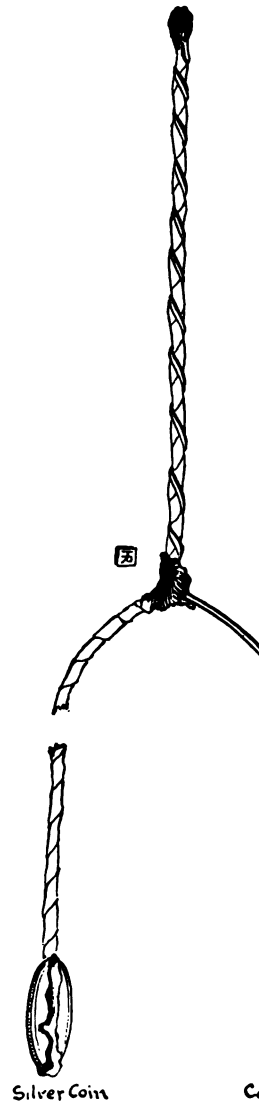


FIG. 38.

and the uninsulated wires together, forming a twisted double wire about eight inches in length, which is to be the probe. The insulation of the first wire may now be more roughly continued by wrapping it with adhesive plaster, leaving three or four inches at the extremity farthest from the tip of the probe uncovered. One wire should now be firmly wrapped round a piece of zinc or silver as large as a medium-sized coin, and the other wrapped round a piece of copper of similar size and shape. A copper and a silver coin will do. The connection of the wire with the silver or the zinc piece should be carefully and completely covered with sealing-wax. Now, going back to the distal end of the probe, the two bright ends of wire should be cut off so that each shall be the eighth of an inch

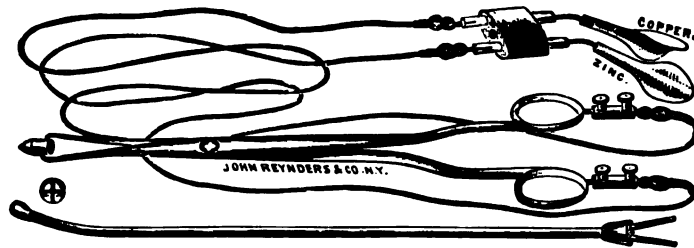


FIG. 39.

long and then bent so as to bring the tips the sixteenth of an inch apart. They should nowhere touch each other. A drop of melted sealing-wax will fix them in position, and at the same time act as a button or head for the probe. If the tips of the wires are covered by the wax, they should be exposed with the help of a sterilized file. The two coins are to be placed in the operator's mouth, one at each side of the tongue, and not touching each other. As soon as both wires at the tip of the probe are in contact with metal, a peculiar and unmistakable sensation is imparted to the tongue of the operator, and continues as long as the contact lasts, vanishing instantly when one of the terminal wires no longer touches the bullet or other metallic body. The larger the pieces of dissimilar metals, the stronger will be the electrical action and the more dis-

tinct the sensation. It is important that the wires and the metal pieces should be bright. The ingenuity of the individual will suggest modifications in the manufacture of this improvised instrument, such, for example, as using a small-calibered rubber tube instead of the adhesive plaster to make the insulation, etc. If rubber tubing is used for this purpose, the instrument may, of course, be sterilized by boiling after it is finished, with the exception of the tip. The sealing-wax button should then be adjusted last of all. A probe and bullet-forceps made on this principle may be purchased at the instrument-maker's. (Fig. 39.)

CHAPTER III

OPERATING IN A DWELLING-ROOM

WHEN one is obliged to do surgical work in an ordinary dwelling it is best to imitate as closely as possible the conditions which we have in a hospital operating-room. With a little care and originality things may be arranged well enough to permit one to work in comparative comfort; while the results in the cases which are operated upon under these circumstances, will compare very favorably with the results of similar work done with the best appliances. Strict attention to detail, and an eye to all possible emergencies, are points requiring particular emphasis, while resourcefulness in the face of the unexpected is a quality of the greatest value. It is well worth while if there is time — and there generally is — to take a brief glance at the anatomy of the region to be invaded, paying attention especially to the *nerves* which may be in our way. They are usually of greater importance than the blood-vessels.

The Room. — When there is a choice between rooms, preference should be given the one where the light is best. It is also well to see that the water-supply is near at hand.

No preliminary sweeping, dusting, or dismantling of the room should be permitted, for the flying particles of dust may get into the wound, and become the starting-points of infection. Caged birds or other small household pets had better be removed, however, for the fumes of the anæsthetic may kill them. Clean towels or clean sheets should be spread upon all pieces of furniture which are likely to come in contact with the operator or his assistants, or with anything which may touch the patient. If the floor is bare, it may be sprinkled to settle the dust.



FIG. 40. — A dwelling-room. No preparations for operation have been made.

Soap smeared over the window panes will discourage prying neighbors, while it interferes very little with the entrance of light.

Surgical Furniture. — An ordinary wooden kitchen table makes an excellent operating-table. If the one at hand is not long enough, it may be supplemented by a smaller one placed at its head or at its foot, and it should be remembered that the steadier table should be the one to support that part of the patient's body which is to be operated upon. The table should be covered with a folded quilt or blanket, and over this should be spread a layer of waterproof material of some sort, such as a piece of rubber-cloth or oil-cloth, a clean sheet covering the whole and hanging well down over the sides. A clean pillow-case stuffed not too full of hay, fine shavings, or "excelsior," will be found useful to elevate the shoulders of the patient if the operation is to be about the neck or jaw. Another table, which need not be so large, is to be used for the instruments. It must be covered with a clean sheet or a large towel.

Three or more wooden chairs, their seats covered with towels, will be required to hold basins with solutions for cleansing the hands of the surgeon and his assistants and for the sponges. Other wooden chairs may be needed if the operation happens to be one where the surgeon and chief assistant must sit at their work.

Utensils. — A long china platter, an agate baking-pan, or a *new* tin pan will be required for the instruments. Half a dozen soup-plates are useful for holding various things, — one for the ligatures, one for the sutures and needles, one for the artery forceps, etc.,. It is best to reject a cracked dish, for it is not easily cleaned. A pitcher of known capacity, say a quart, may be used to measure out water for the solutions, and it will be found convenient to keep these lotions in three or four clean wine bottles until they are needed. Three basins, china or agate, are for the sponges, and for the solutions to disinfect the hands. Bright metal utensils are not to be used for corrosive sublimate solutions, because the chemical



FIG. 41. — The room shown in Fig. 40. It is now arranged as an operating room. Everything is in readiness. The dressings are laid out upon the bed in the order in which they will probably be needed. Before the operation begins they must be covered with a clean towel.

is apt to be decomposed by contact with them. A slop-jar or waste-pail must not be forgotten.

Dressings.—Several yards of sterilized absorbent gauze or other similar material should be at hand to be used as a dressing, and also a quantity of absorbent cotton to cover the actual wound-dressing, and to protect the skin of the patient from being chafed or cut by the bandage. There should also be plenty of pins and roller bandages, though it will sometimes be found convenient to sew the dressings and bandages with ordinary needle and thread instead of pinning them. Pads for sponging may be made from the gauze, and are to be preferred to any except the most carefully disinfected reef sponges.

From one to three dozen towels should be provided according to the magnitude of the proposed operation. If so many towels are not to be had, old sheets torn into pieces of suitable size may be used instead. These sheets must be clean, and they may be fairly well sterilized by going over them with a very hot flat-iron. In an emergency these same rags may even be used as sponges and dressings.

The platter, the plates, the pitcher, the bottles, and the basins should all be carefully washed, rinsed, laid in a large towel or sheet, and put into a large clothes boiler with plenty of water to boil for ten minutes. The ends of the towel or sheet should be allowed to overhang the edge of the boiler, so that the utensils may be removed by grasping these ends and lifting the articles as in a bag from the hot water. Once out of the water it is not necessary to dry the dishes, and they should on no account be set down upon any undisinfected surface. This is especially to be noted in regard to the pitcher, the outside of which must always be as clean as the inside, for it will be used to dip the water out of the boiler. The water in which the dishes have been boiled is assumed to be sterile, and may be used as such during the operation.

If the instruments have not been sterilized by the surgeon at home, they may now be boiled in a solution of washing soda

(carbonate of sodium), one heaping tablespoonful to each quart of water for fifteen minutes (see Chapter I.), and then immersed in a solution of carbolic acid, one tablespoonful to the quart, from which they are to be used. The sutures and ligatures should not be immersed.

Arrangement of the Instruments, etc.—The instruments and the dressings should be arranged ready for use so that no time may be lost in searching for things when they are needed. It is best to place the instruments in a certain order; those most frequently used in the left half of the tray, and the others in the right. It will be found convenient to have the artery-clamps in a deep bowl or plate by themselves. A number of ligatures, already cut in proper lengths, should be neatly laid out in one of the plates so that they may be taken up one by one without their getting entangled. Needles threaded with the sutures must be in a separate plate. The dressings should be arranged in the order in which it is expected that they will be used, and may then be folded in a towel and put aside till needed.

Operator and Assistants.—Too many assistants are better than too few, though it is unwise to permit any hand except that of the operator to come in contact with the wound. The operator and the assistants should scrub to the elbows for five minutes with a stiff nail-brush or hand-scrub in soap and water to which ammonia-water has been added in the proportion of about half a teaspoonful to the quart. Particular care must be taken with the nails and the subungual spaces, which should be cleared of foreign matter with a blunt nail-cleaner. If no nail-brush or hand-scrub can be obtained, a new scrubbing-brush may be pressed into service for cleansing the hands, and also for scrubbing the patient at the site of the operation. After the soap and ammonia-water scrub, the hands should be once more scrubbed with a solution of corrosive sublimate, one to a thousand.

Instead of an operating-gown a clean sheet pinned apron-fashion about the neck and the waist will guard against the contact of



FIG. 42. — The operation about to begin. Because of the light it has been necessary to reverse the position of the patient. The small stand with apparatus, etc., for the anesthesia has been moved to what is now the head of the table.

clean or disinfected articles with the clothing of the operator. The assistants should be similarly draped. Clean night-shirts may also be used in place of operating-gowns. The surgeon and chief assistant should wear caps improvised with towels or pieces of gauze (Fig. 42). (For special preparation see other chapters.)

The Patient. — The field of operation as well as a considerable area of the surrounding skin should be shaved, whether it is hairy or not, and then well scrubbed with soap-water and ammonia. After wiping the part dry the region should be briskly rubbed with the end of a towel soaked with ether or alcohol, and finally should be bathed in sublimate solution, one to five hundred. The patient should be covered with dry blankets so that he may not suffer from exposure to cold, and over these blankets clean sheets or towels should be spread. In the neighborhood of the operative field towels wet with sublimate solution, one to a thousand, must be spread, and all parts except the site of the proposed operation must be kept covered. If the work to be done is about the face, the neck, or the upper part of the thorax, a wet towel should be wound about the patient's head and pinned in place so that the hair may not touch the surgeon's hands or the instruments.

The Anæsthetic. — In "acute" surgery, where more has to be done than the making of a mere incision, it is generally best to employ narcosis, and, all things considered, ether is the anæsthetic to be preferred. Local anæsthesia is, however, of great value in certain major work. It will be discussed in the chapters devoted to these operations.

Cone. — Six or seven thicknesses of newspaper folded into a pad about sixteen inches long and five inches wide, and then folded neatly into a towel or napkin, the whole to be held by means of pins in the form of an oval ring, will form the frame of the inhaler. This ring should be made of such a size that it will nicely cover the mouth and nose of the patient. A mass of loose rags or gauze pinned in place so as to fill one end of the ring completes the apparatus.

When ether cannot be had, it may be necessary to use chloroform. Instead of the inhaler just described, which would be dangerous if used for the administration of chloroform, it is but necessary to fold a napkin or handkerchief into a little pad just large enough to cover the patient's nostrils and mouth. The pad may be conveniently held with a dressing-forceps.

CHAPTER IV

OPERATING IN A DWELLING-ROOM (*Continued*)

Assistants and their Duties. — It is necessary to exercise considerable care in assigning duties to the various assistants, and this is especially true in those emergencies where one has to accept the services of laymen as well as of physicians, or where no medical man is at hand to give help.

The administration of the anæsthetic should be entrusted to the most experienced person. Nearly any intelligent individual may assist at the wound, but it requires skill and experience to anæsthetize in such a manner as to leave the operator free to attend to his part of the work without anxiety or annoyance. The anæsthetist must not pay attention to anything except his own task, and he should keep constant and careful watch over his charge.

Where there is unskilled assistance, it becomes the duty of the surgeon to supervise most carefully the cleansing and disinfection of the hands of those who are to help him, and also to be on the alert for any errors of asepsis from the beginning to the end of the operation.

At an ordinary operation requiring anæsthesia there should be at least two assistants besides the anæsthetist, although the surgeon may at times be forced to get on as best he may with but a single helper. (This matter will be further discussed in the chapters devoted to Regional Surgery.) Where there are two assistants besides the narcotizer, it should be the duty of the one to assist at the wound and to hand instruments, while the other attends to

the cleansing and passing of the sponges as well as to the changing of the solutions when they become dirty or turbid. This assistant may also be required to lend a hand at the wound when his other duties will permit. If more assistants are available, one may relieve the man at the sponges of the duty of keeping the solutions clean, and may also look after the necessary moving of furniture or the handling of undisinfected articles during the operation. This person should on no account be permitted to come in contact, direct or indirect, with the wound or with the operator or the disinfected assistants.

Arrangement of Furniture. — The operating-table should be placed in such a position that the surgeon may not stand in his own light, and the other tables and the chairs should be within easy reach of those who are to make use of them. A small table or a chair should be at the head of the operating-table to hold whatever the anæsthetist may need in the way of instruments, narcotics, stimulating drugs, etc.

The Anæsthesia. — The great importance of the safe administering of the anæsthetic cannot be overestimated, and the operator should be convinced that the narcotizer is fully alive to his responsibility. At the head of the table, beside the anæsthetist, should be the smaller table or the chair already mentioned, covered with a clean towel. It should hold the bottle or the can containing the anæsthetic, the cone or inhaler, a stout dressing-forceps, a gag for separating the jaws, two or three clean towels, a pus basin or substitute, to be used in case the patient should vomit, and a hypodermic syringe filled with a solution containing the twentieth of a grain of the nitrate or the sulphate of strychnine to be used as a stimulant should the patient collapse. A few ounces of good brandy or whiskey for hypodermic use should also be ready in case further stimulation becomes necessary.

Unless the patient will suffer pain in the moving, it is best to transfer him from the bed to the table before anæsthetizing him; but if he is nervous and likely to be alarmed at the sight of the

preparations he may be anæsthetized in bed, the transfer being made during the narcosis. One man of average strength can carry a patient weighing a hundred and thirty pounds very comfortably in the manner shown in the illustration. (Fig. 43.) If the patient is heavy or unwieldy, or if it is needful to avoid disturbing his position, it may require the united efforts of two or three persons to carry him. A good method consists in placing a board beside the patient in bed, and then, having lifted him upon it, to carry him as he lies on the board to the operating-table. An ordinary ironing-board will be found useful for this purpose. It should be carefully tested to see that it is strong enough to bear the necessary weight.

Ether. — If the patient is nervous and frightened, the eighth of a grain of morphine may be thrown under the skin half an hour before beginning the narcotization more as a sedative than as a true analgesic. The patient's chest should be examined to note the condition of the heart and lungs, and he should be instructed to remove artificial teeth, obturators, or any substances which he may have been chewing.

The head should rest upon a thin pillow, and when unconsciousness has been established even this should be removed. The gauze in the cone should now be well saturated with ether, and the inhalation may be commenced, the cone being held about an inch from the patient's face. As soon as he has become somewhat used to the odor, and to the first irritation of the mucous



FIG. 43.

membranes caused by the drug, which may be in from two to five minutes, the inhaler should be adapted firmly about the mouth and nose in such a manner as to exclude all air not impregnated with the ether-fumes. At this point there may be a slight degree of cyanosis with some irregularity of the respiration and often of the pulse, and the patient will usually struggle more or less violently, the condition being called the stage of excitement. An assistant or two should be at hand to restrain him, so that he may not do injury to himself or to the anæsthetist. In restraining a struggling patient the greatest care must be taken to avoid harming him. His arms should be held at his sides by *lightly* grasping both wrists, and *pressing them firmly* against the table or the bed, in the manner shown in Fig. 44, while the anæsthetist should take special care that the patient shall not raise his head. If we have to deal with a particularly strong and active individual, it may be necessary to prevent his kicking by keeping his legs extended through pressure at the knees. The stage of excitement is often exceedingly disagreeable in the case of persons who are accustomed to the use of alcohol. They are apt to become rigid, and very cyanotic from spasm of the muscles of respiration. Tremor, too, is an annoying symptom which sometimes appears in these cases. If the stage of excitement continues for more than five or six minutes unabated, it will be necessary to administer another hypodermic dose of morphine. The stage of excitement usually ends rather abruptly, the patient breathes regularly, often snores loudly, and the muscles become relaxed. To test whether the narcosis is complete, one has but to briskly flex and extend the patient's elbow a few times, when, if he is not yet sufficiently under the influence of the anæsthetic, there will be a more or less marked resistance, while if the narcosis is complete motion will be free and unimpeded. It is not necessary in the great majority of cases to touch the cornea or the conjunctiva in order to assure one's self that the patient is anæsthetized, and it must be remembered that serious harm may be done to the eye by such treatment. By rais-

ing and lowering the upper lid the reaction of the pupil to light may be observed. Sudden, extreme dilation of the pupils during full anæsthesia is a sign of dangerously profound narcosis, a state which should never be reached.

The patient's arms may be fastened up out of the way by means of bandages or by pinning the sleeves to the sheet which



FIG. 44. — Humane manner of restraining a patient struggling in the stage of excitement.

covers the operating table, but they should not be raised too high, for fear of paralysis caused by pressure of the head of the humerus upon the plexus in the axilla. When such paralysis occurs after a trivial surgical procedure, it is particularly annoying, for it often persists long after the recovery from the condition for which the operation was undertaken. The angle which the humerus should

form with the axis of the body should never be greater than ninety degrees.

The pulse during etherization should be full and steady, unless the patient is coming out from the influence of the drug or is about to vomit, when it often becomes weaker and accelerated. It is a common fault to administer ether in quantities far in excess of the requirements of the case in the mistaken belief that a little more can do no harm. This is a grave error, and has cost many a human life. Ether is to be regarded as a poison. No more of it should be used than will suffice to keep the patient quietly anæsthetized, pouring small quantities at a time into the cone. Should the patient threaten to vomit, an attempt to check it may be made by forcing the ether for a moment. If, however, it appears that the vomiting is inevitable, the patient's head must be turned to one side, and all attempts to continue the etherization discontinued until the respirations once more become regular. Extreme stertor may indicate that there is a collection of mucus in the throat. The jaws must be carefully forced apart, a gag inserted between the teeth, and the throat well wiped out with a sponge or a piece of gauze, held in a dressing-forceps. If ineffectual efforts at respiration occur, it is probable that the larynx has become obstructed, perhaps by the epiglottis. It will then be necessary to hyper-extend the head, and to push the jaws forward in a firm but careful manner. (Fig. 45.) Sometimes the apnœa is caused by the tongue, which may have fallen backward. It must then be drawn forward by means of a forceps or, better still, by a silk suture, which should be run transversely through the tongue about half-way back from the tip, and tied in a loop. (Fig. 46.) This is a more humane method than that of the forceps, and the patient seldom notes any soreness about his tongue after the operation. Should true spasm of the glottis threaten life, recourse may be had to tracheotomy and artificial respiration.

Chloroform. — The poisonous dose of chloroform is smaller than that of ether. If no proper mask for the inhalation of this anæ-

thetic is at hand, a folded handkerchief or even a thick piece of blotting paper may be utilized. Plenty of air should always be admitted with the chloroform, and the inhaling mask should seldom, if ever, touch the face; for chloroform kept for some minutes in con-



FIG. 45.—Chloroform. Patient's head hyper-extended and jaws pushed forward.

tact with the living human skin will cause a troublesome dermatitis which resembles a burn. The accident may be avoided by freely anointing the face with vaseline or some similar grease before beginning the anæsthetization.

In the supervention of chloroform narcosis the stage of excitement is often absent, and it should be the object of the narcotizer

to avoid it if possible. It may often be prevented by administering the anæsthetic slowly or at the rate of about two drops to the second, until the patient is anæsthetized, stopping the drug altogether at the very first sign of resistance or excitement, and resuming it again the moment the patient becomes quiet. A struggle during the administration of chloroform may prove disastrous because of the



FIG. 46. — Gag in position, and tongue drawn out by a fillet of silk.

undoubted tendency of the drug to produce heart paralysis. Cyanosis, too, not especially alarming during the struggles of a patient in the stage of excitement from the administration of ether, is always of grave import during any stage of chloroform anæsthesia.

If an individual is once well under the influence of chloroform, the drug should be administered in small quantities and the patient kept just within the boundaries of surgical anæsthesia. Neither

cyanosis nor stertor should be permitted, and if it seems impossible to avoid these symptoms, the chloroform must be stopped and ether substituted.

Sudden heart-failure may occur either at the beginning of chloroform administration or after long-continued anæsthesia. When it occurs at the beginning or even before narcosis has been established, it is caused by actual cardiac paralysis. The syncope should be treated by artificial respiration accompanied by rhythmic thrusts with the thumb upon the chest-wall over the apex of the heart at the rate of about one hundred to the minute. One should assure himself by auscultation that the throat is clear, and that the air is actually passing into the lungs during the artificial respiration. In the event of syncope coming on later in the anæsthesia, artificial respiration in the horizontal posture will usually resuscitate the patient, though here, too, the rapid sharp impulses will act as a useful local stimulant. The anæmia of the respiratory centres may be partly overcome by placing the patient in an inclined position with the head lowermost, — a posture which is to be avoided in syncope at the beginning of narcosis. Strychnine is a valuable stimulant in any form of chloroform heart-failure, and it should be given in sufficient quantity, say a tenth or even an eighth of a grain.

When the operation has been completed, and the administration of the chloroform has been discontinued, a napkin or chloroform-mask saturated with vinegar may be placed over the patient's nose and mouth, because the acetic fumes often prevent the vomiting which usually follows chloroform anæsthesia.

Local Anæsthesia. — Cocaine hydrochlorate in four per cent. solution made with sterilized or boiled six-tenths per cent. salt solution may be injected into the skin (not under it) along the line of the proposed incision. Not more than thirty minims should be used, for the drug occasionally acts as a poison, causing, in some instances, dangerous syncope and even death.

Beta-eucaine is a much safer drug, though its action is somewhat slower than that of cocaine. It may be used in two to three per

cent. solution, which may be sterilized by boiling, without causing changes in the drug. As much as a hundred minims may be administered during a single operation by injection into the skin.

The Incision. — In the operations of imperative surgery, it is best to make the wound through the skin ample, for careful work with the aid of sight as well as touch cannot be done through too small an orifice. In making the primary incision, one should



FIG. 47. — The primary incision. Skin put upon the stretch to prevent wrinkling.

decide upon its direction according to the region to be invaded. (See chapters on Regional Surgery.) The operator and an assistant should stretch the skin so that there may be no wrinkling as the knife passes through the tissues; otherwise the incision becomes irregular. (See Fig. 47.)

Dissection. — As soon as the incision is made, its edges should be separated by sharp retracting-hooks, which should be managed by the assistants or by the operator and one assistant. In holding the lips of the wound apart they should, at the same time, be

raised up away from the parts beneath. The dissection may now proceed to the other tissues, the retractors grasping deeper and deeper, but at the same time always being drawn upward as well as apart. In this way it is possible to see the various structures very easily, and to recognize vein, artery, and nerve, while, if the

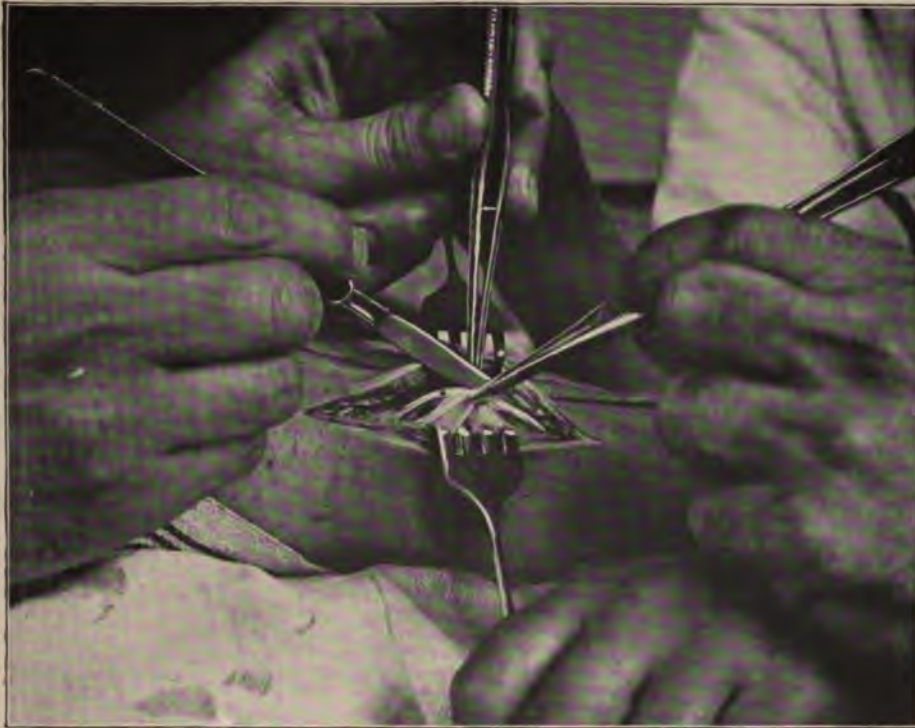


FIG. 48. — Dissection between mousetooth-forceps.

wound is simply held open and its edges not raised, the vessels become invisible because they are emptied by pressure against the underlying tissues. By pursuing the proper method one is usually able to secure blood-vessels before they have been cut instead of having to fish about for a bleeding artery or vein whose ends have retracted into the surrounding tissue. In approaching delicate regions, it is best to proceed very carefully, cutting through the

different layers in succession between two mousetooth-forceps, one of which is managed by an assistant and the other by the surgeon, who should always be the first one to take hold, the assistant then grasping the same tissue about a quarter of an inch away. (Fig. 48.) This is a far better method than the old way of cutting on a grooved director, an instrument which, by the way, has almost lost its usefulness.



FIG. 49. — Artery secured by clamps and about to be divided.

When an instrument has come in contact with a septic portion of the wound, it should not be returned to the same pan with the clean ones, but should be placed in another vessel and should not be used again unless it has been sterilized or is to be employed about the same dirty region.

Hemostasis. — Upon the prevention and prompt checking of hemorrhage depends not only the minimizing of shock after many operations, but also the lessening of the chances of septic infection; for blood-clot is a favorite soil for the development of pathogenic germs. The best method for securing blood-vessels is by the

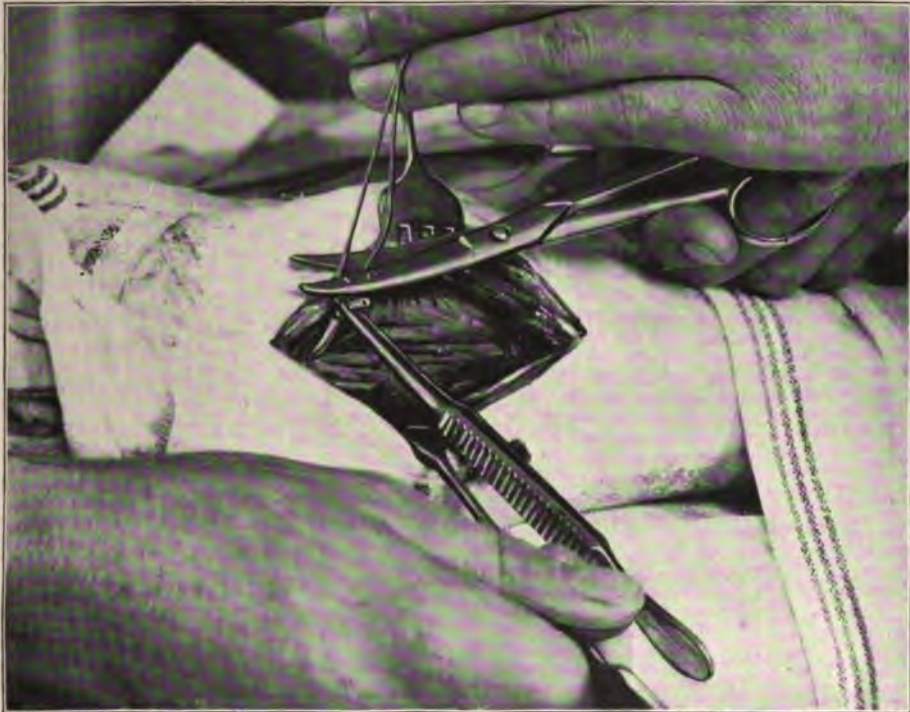


FIG. 50. — The artery has now been cut. The distal ligated portion has retracted and cannot be seen. The ligature of the proximal portion is being shortened with the scissors.

clamp, or artery-forceps, and ligature. When the vessel is recognized before it is cut, it should be caught by two clamps and then divided, each end being secured by ligation. (Figs. 49 and 50.) If a spurting vessel is actually seen, it is usually easily secured by a clamp. However, if there is no spurt but, nevertheless, hemorrhage, an assistant should rapidly wipe the place with a sponge wrung out dry, and after each wipe should at once get his hand out of the

way so that the operator may note the point of bleeding. The bleeding point will then usually be easily seen, and the vessel may be caught and ligated. A general idea of the direction whence bleeding may be expected can be had by keeping in mind the anatomy of the blood-supply of the region. It is a good rule, when one is working in the neighborhood of large and important arteries or veins, to expose the vessels first and then work away from them. If the ligation of a really large vessel becomes necessary, it is best to isolate it so that nothing but the vessel itself

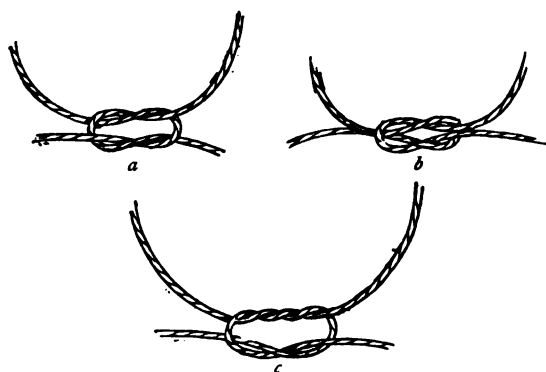


FIG. 51. — *a*, "Grannie;" *b*, Square knot; *c*, Friction knot.

shall be caught in the ligature, and if the appearance of unlooked-for hemorrhage has forced one to include several vessels in one ligature, they should afterward be tied singly so that they may be safe in case the mass-ligature should slip. For tying arteries or veins a square knot should be

employed, and not the so-called "grannie." (Fig. 51.)

When working in tissue made dense by cicatrization or by inflammation, it sometimes happens that it is difficult or even impossible to secure the bleeding points by the clamp or forceps; yet just here the danger is very great, for the mouths of the vessels remain open because of the stiffness of the surrounding parts, and the bleeding is, consequently, severe. It may then be necessary to secure the vessel by means of a suture, which passes through the tissues on either side and is then tightened as is shown in the illustration. (Fig. 52.)

Sudden and severe hemorrhage may generally be kept in check for the time being by pressure made with the finger or by means of firm packings of gauze or sponge. It is unwise, however, to depend

wholly upon these packings, so they had better be removed bit by bit, and the actual source of the bleeding sought out and controlled.

When removing a mass of tissue by excision, as, for example, a tumor, it is not necessary to ligate the bleeding points which are upon the mass itself, but merely to clamp them while those of the proximal part of the wound must be well secured by ligature. In the removal of large vascular masses this method saves much time.

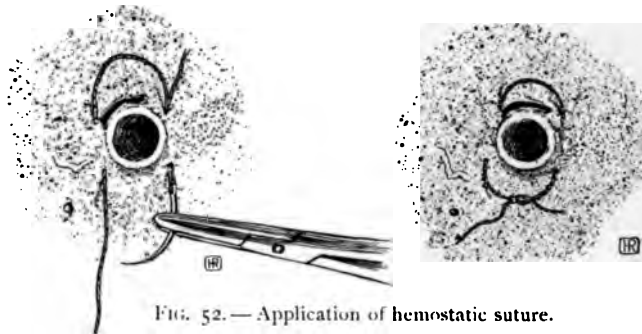


FIG. 52. — Application of hemostatic suture.

When the rubber constrictor has been employed, it is best to secure the vessels before releasing the band. Milking the limb toward the cut surface will cause a little point of blood to appear at the mouth of each artery and vein, showing plainly their location. If this has been carefully done and the possibility of hemorrhage on releasing the rubber is still feared, pressure upon the wound may be made with sponges partly saturated with hot water and kept up for several minutes after the removal of the constrictor. This is a safe method, especially where large vessels are known to have been divided, as in major amputations.

Drainage. — The question of the advisability of drainage will be taken up in the discussion of the various different operations, for it is a matter which depends largely on the location and type of the wound. Drainage may be accomplished by means of strips of gauze, by rolled-up cylinders or folded pieces of gutta-percha tissue, and by tubes of rubber or other material. A boiled red-rubber catheter makes an excellent drainage-tube. All tubes should have lateral openings cut into their walls with scissors

(Fig. 53). The drain should be carried quite down to the bottom of the wound, and it should be fastened to the skin by a suture, or it may be held in place by the dressings and prevented from slipping wholly into the wound by a transfixing safety-pin. (Fig. 57.)

In accomplishing the drainage of a wound, the fact that fluids run down hill must not be overlooked, and the opening left for drainage should therefore be at the lowest practicable point, considering the patient's position in bed. Capillarity, of course, may be made use of to a certain extent, as in the case of the gauze



FIG. 53. — Fenestrating a rubber drainage-tube.

strips and wicks which suck out, as it were, the wound-secretions; but wounds drained in this way need careful watching, for the gauze will not drain out thick pus and may even act as a plug, thus doing more harm than good. In normally healing wounds, the drain should be removed as soon as the first discharge of bloody serum has entirely ceased, which will be in from one to five or six days. If there is suppuration, the drainage must be continued until the discharge of pus has ceased, though the drain itself should be shortened or made thinner according to the changes in the conformation of the cavity to be emptied.

Closing the Wound. — An actually septic wound should not be closed by suture, but the entire cavity should be packed with strips of gauze, allowing one end of each strip to project from the opening in order to facilitate its removal. If the cavity to be packed is a very large one, a good way is to line it throughout with a single layer of gauze, the edges of which shall project all around, and then to pack this lined cavity with strips of gauze as firmly as may be necessary. The advantage of this is that when it is time to remove the packings the strips may be detached and taken out without disturbing the layer which is in contact with the tissues. This layer may then be removed without trouble, and there will be little or no pain or bleeding.

When it is decided that a wound may be closed by suture, catgut or other absorbable material may be used for bringing together the deeper tissues, while silk, as fine as will stand the strain, is most suitable for the skin. Fine full-curved needles and a needle-holder should be used (Chapter I.). If there is so much tension that it is feared the stitches may tear out, a few stronger ones may be put in at intervals to take the strain from the others. These tension sutures, if put in in the usual manner, are apt to cut the skin. A good method is to put the suture through double, and to tie a sterilized porcelain or metal button to each end while an assistant approximates the tissues. (Fig. 54.) A pad of gauze placed beneath each button will in great measure prevent pressure necrosis of the skin. Even in a clean wound, perfect healing depends on the accurate and painstaking adaptation of the cut edges. In order to be sure that they shall not be inverted, it is best to have an assistant turn them out with a mousetooth-forceps, as shown in the figure (Fig. 33), and to sew close to the edges of the skin. The interrupted suture is usually to be preferred.

The Dressing. — As a general principle, it may be said that infected wounds should be dressed wet, and those known to be uninfected, dry. Dry dressings must be clean in the strictest surgical sense. If there is any doubt as to the actual sterility of the

dressing material, a half-yard of it may be rendered perfectly safe by scorching it with a hot flat-iron, taking care that nothing undisinfected shall come in contact with this piece after it has been scorched. This may be folded into a pad of suitable size, and is to be placed next to the wound and covered with masses of absorbent material, the whole to be bandaged in place.



FIG. 54.—A partly sutured wound. Tension sutures with buttons.

Septic wounds do best when enveloped in soaking wet dressings covered with oil-skin, gutta percha tissue, or other waterproof substance. In default of something better, a piece of paper which has been well oiled will make a satisfactory temporary covering. (Chapter I.) An excellent fluid for a wet dressing is the solution of the acetate of aluminium. (Chapter I.) This should be further diluted, when it is to be used, in the proportion of one part to four of water. In an emergency, common salt solution, a tea-

spoonful of salt to a quart of water, may be boiled and used to moisten the dressings.

Shock and Collapse. — When in the course of an operation or soon afterward, the patient becomes collapsed either as a result of pure shock or because of the loss of blood, stimulation is demanded. The earliest alarming symptom is, usually, the progressive weakening and rapidity of the pulse, and this is generally accompanied by shallow respiration and pallor or cyanosis of the body-surface. The skin then becomes moist and clammy, the temperature lowered, the reflexes diminished, and the pupils dilated. If the patient is conscious, restlessness and sighing respiration will also be noted, together with an anxious expression of the features. The symptoms of concealed hemorrhage are the same as those just mentioned, with, perhaps, a rather more emphatic pallor and a very steady progression from bad to worse. Either condition calls for active stimulation, and, in the case of concealed hemorrhage, the infusion into the system of normal (one-sixth per cent.) salt solution is imperative, though this infusion will also be of great benefit in collapse without hemorrhage. In cases of hemorrhage, naturally the first and most important thing to do is to check the bleeding. The saline infusion is then but a stepping-stone, stimulating the patient so that he may endure the necessary manipulations. In administering chemical stimulation it is unwise to multiply the number of drugs used, thereby, perhaps, even poisoning the patient. A tenth to an eighth of a grain of the sulphate or, better, the nitrate of strychnine in divided doses given hypodermically, followed by two or three ounces of brandy, also under the skin, will generally act satisfactorily, while digitalis, morphine, atropine, strychnine, nitroglycerine, etc., in quick succession will, to say the least, leave doubt as to which drug is acting should toxic symptoms arise. Simplicity in stimulation by drugs will enable one to keep a far more intelligent watch of the patient's condition. The method which is the most potent of all in whipping up the flagging vital forces is the saline infusion directly into the circulation. The

intra-venous way is, perhaps, the simplest and most efficient. It is never wise to undertake an operation where there is apt to be severe hemorrhage or profound shock without being prepared to infuse at the shortest notice. The infusion should be performed coincidentally with the other efforts at stimulation.

The instruments necessary for infusion are a scalpel, a pair of small, sharp retractors, a thumb-forceps, a cannula, and an irrigating bag or bottle, the bottle to be preferred. If a rubber irrigating bag is used, it should be perfectly new if possible. A pair of scissors and two artery-clamps may also be found of use, and catgut ligatures should be at hand. The fluid for infusing should be thoroughly sterile and filtered; it should be made with distilled water, except in the gravest emergency, when, if no distilled water is to be had, boiled and filtered water from the tap may take its place. A level teaspoonful of salt to each quart of water is sufficiently near the correct proportion, and the solution should be boiled after it is made. When rain-water or melted fresh snow can be had, it is better than tap water, but this, too, must be filtered through absorbent cotton in a funnel and well boiled. The irrigating bag or bottle must be thoroughly boiled in one per cent. soda solution, and then flushed out with some of the salt solution in order to wash away the soda. It is necessary to knead the tube with the fingers throughout its whole length while a stream of water passes through it to get rid of the powder which is nearly always found on new rubber, and this should be done before the final flushing with the saline fluid. If a rubber irrigating bag or fountain syringe is to be used, it also must be kneaded and washed out. Although the operation of intra-venous infusion is a very simple one, it requires, in order to be safe, the most rigid precaution to prevent the entrance of any foreign substance, whether septic or not, into the blood-current, and it must be remembered that air and blood-clot come under this heading. The cannula should be firmly tied into the irrigator-tubing so that it may not slip out during the infusion, and the irrigator must be filled with the solu-

tion at a temperature of 110° Fahr., or at a temperature as near as possible to this. A few turns of roller bandage should be tightened about the patient's arm at the level of the deltoid insertion so as to impede the venous return while it does not check the pulse at the wrist. The veins below the bandage will now fill and become very prominent. The skin at the elbow having been disinfected, a longitudinal incision is made over one of the turgid anterior veins. In order that the vessel may not be accidentally injured, this incision may be made by transfixing with the scalpel a fold of skin picked up between the fingers, or this incision may even be made by snipping the raised fold of skin with a sharp pair of scissors. The little wound should now be held apart by retractors, and the vein clearly exposed for about three-quarters of an inch. The thumb-forceps is then to be passed beneath the vessel and with its aid two ligatures of fine catgut are to be drawn through so that they shall lie beneath the vein and across it in a position ready for tightening. The two ligatures should be held up rather firmly, the upper one being drawn upward and the lower one downward, so that they shall temporarily check the blood-stream, and an incision should be made longitudinally between them into the vein. Into this opening the cannula is to be slipped *while the stream of saline fluid is running*, and not until the tube has been completely emptied of air. The greatest care should be exercised that the cannula should actually enter the lumen of the vessel and not force a way alongside of it nor between the vascular coats. The upper ligature must now be tied firmly, but with a bow-knot, around the cannula in the vein, the lower ligature tied with a full knot, and the tight bandage about the arm cut off to free the circulation. By placing a finger lightly upon the arm over the vein close to the cannula and above it, one may feel the thrill of the fluid as it runs in. The pulse will now improve, and the patient's general condition will also usually become better. From one to one and a half quarts of the solution may be permitted to enter the circulation, when the cannula should be withdrawn, and the ligature which was

tied in a bow-knot should be slipped, and the vein at once firmly tied with the usual square knot. The vein between the ligatures should now be divided, the little wound closed by one or two sutures and a dressing applied. Should the patient's condition later demand a second infusion, it had better be made through another vein, for it is dangerous to leave the cannula in position after the fluid has ceased to run, on account of the formation of blood-clot, which by another infusion might be forced into the circulation, causing embolism. A few hours after an infusion there is often a rise of temperature, the exact cause of which is unknown, and there is also occasionally a chill. These phenomena are not usually omens of evil.

CHAPTER V

THE HEALING OF WOUNDS

Aseptic Healing.—A wound which is perfectly aseptic heals without symptoms, provided it is kept at rest. If there is tension of any kind, the condition of rest cannot, of course, be said to exist, and there may be pain even though there be no sepsis. Thus, a wound whose parts are held easily in the position which they occupied before there was a wound should, after the first few hours, be perfectly painless, while in cases where it has been necessary to remove portions of the skin and draw the lips of the defect strongly together the condition of rest is disturbed by the constant tension of the parts toward their normal position, and more or less pain results. This painlessness of aseptic wounds is noted even when the most extensive incisions have been made.

The cutaneous edges of an aseptic wound become agglutinated by organized adhesions strong enough to permit of the removal of the sutures in from four to five days, but it is necessary for ten days after the operation to guard against extraordinary strains which may tear them apart. Fascia, tendon, and ligament are slower to heal, three weeks being the shortest limit of safety after which strain on the wounded parts may be permitted. During this entire time the structures should be well protected from all motion. Bone requires still longer for its regeneration, from four to six weeks being the usual time in adults during which the injured tissue should be at rest. It must be understood that in this instance by rest is meant local rest. It is not necessary to forbid, even in wounds of the bones, all motion of the injured part as

a whole, but simply such motion as may tend to separate the parts held in contact by the dressing. The ambulant treatment of fractures, for example, permits the patient to walk about with the aid of a proper splint during the time of healing.

In judging of the ultimate result, especially where more than the skin has been wounded, it must be remembered that no true estimate can be formed until the process of atrophy of the scar is complete. This may be a matter of several months or even a year or more. If the cutaneous cicatrix has bleached to a chalky white color, we may assume that the scar will change little if any further, but if one were to judge by the result as it appears immediately after the healing process, disappointment may follow. The fine cicatrix of perfect primary union may spread and hypertrophy into an unsightly keloid, while the massive scar following a wound which has healed by granulation may atrophy so that it will be scarcely noticeable.

After the first discharge of bloody serum from a wound entirely closed by suture, there should be little if any soiling of the dressings, and the line of suture as well as its neighborhood should be dry at the first inspection.

If a completely sutured wound has been found clean, and all precautions have been observed at the first dressing, it is probable that no infection will take place, and that healing will be complete in the usual time after the operation, considering the kind of tissue involved. In the absence of symptoms, a dry wound should not be dressed after the sutures have been taken out, provided the bandage has not become loose or otherwise disarranged.

Drainage of Aseptic Wounds. — Aseptic wounds, where it has been necessary to leave spaces of considerable size, and, perhaps, irregular shape, must be drained. It is customary to drain these spaces from the most dependent part according to their size and the stiffness of their walls by either tube, gauze, or folded gutta percha tissue. The ones with the more flaccid walls may be drained by gauze, while those where the walls are rigid, and there

is, therefore, a less obliterable cavity, require drainage by tube. If these cavities were not drained, the serum would accumulate, and besides the pain which would probably be caused by the consequent tension there would be the extreme likelihood of ultimate infection. At best there would be considerable delay in healing because of the time necessary for the absorption of so much fluid. These drains must be removed just as soon as they have accomplished their end, which will depend somewhat on the cavity to be emptied, large ones often discharging for four or five days, while small ones may be in condition to permit the removal of the drain in twenty-four or thirty-six hours. A drain left in too long causes the formation of a tract or sinus, which may be quite rebellious to treatment, requiring sometimes another operation for its closure. In dressing wounds where we have cavities which have been drained, the gauze or other padding should be bandaged firmly in position so that the walls of the space may be held in apposition as described in the treatment of hematoma (page 25). At the change of dressings, washing out of the cavity by a stream of liquid forced into the tube should never be permitted unless it is found that frank suppuration is going on. The harm it may do is considerable; for if no sepsis is present, infection may be carried in through some technical error, and, besides, the hydrostatic pressure forces the agglutinated walls of the cavity apart so that the healing process has to begin all over again; while if pus is present in one part, it may be forced into recesses which have up to this time escaped infection. Having withdrawn the drain, gentle massage should be made in the direction of the opening in order to ascertain whether there is any discharge in the depths of the wound, and at the same time palpation may disclose the presence of fluctuating places which have not been properly drained. If the wound seems to be progressing aseptically and normally, the drain may be replaced by a very much smaller one, or, if there is no discharge, it may be omitted altogether and the dressing replaced. Where there has been drainage, it is well to cover the drain-opening with a

very small wet dressing, even if the wound as a whole is dressed dry.

Pain in Aseptic Wounds. — Although wounds which are aseptic usually cause no pain and no fever, there are certain exceptions to this rule. Whenever it has been necessary to employ tension, as, for example, in the closing of a defect in the skin, the pain may be very severe and it may continue for several days. Tension may also cause elevation of temperature and quickening of the pulse, and may, indeed, become a predisposing factor in infection; for tissues are killed by it, and they then become more easily a prey to microbes, which attack, by preference, necrosed parts. It is not allowable, therefore, to ascribe evil symptoms to tension without sepsis unless it is certain that no sepsis exists. In such cases the wound must be often and carefully inspected, so that incipient derangement may be nipped in the bud. It may be necessary to keep up the tension for from seven to ten days, but it will be found that the tissues gradually accustom themselves to an astonishing amount of stretching, and that the pain and other symptoms will vanish, though a feeling of tightness often persists for some time.

Another reason for the careful and frequent inspection of such wounds is that there is danger of necrosis of the tensely drawn flaps, an accident which should be avoided if possible by the timely removal of some or all of the sutures.

Wounds of Bone. — Wounds of bone often cause a great deal of pain which may continue for several days whether there is infection or not. A temperature running to 101° is not unusual and need not, in the absence of other symptoms, cause alarm for the first two or three days. *Increasing* pain and temperature, however, are always indications of danger and call for a change of dressings. Clean wounds of bone are not usually painful after four or five days from the time of operation.

Fever indirectly caused by the Anæsthetic. — The anæsthetic may cause trouble, which manifests itself at times by fever, thus giving rise to apprehension of wound infection. Ether or chloroform may

set up a bronchitis or a broncho-pneumonia accompanied by considerable elevation of temperature, which becomes noticeable before the more characteristic signs of the disease have made their appearance.

Symptoms caused by Complicating Diseases.— Lastly, the patient may be suffering from disorder independent of the condition for which the operation was undertaken, and the symptoms of the older trouble may be mistaken for indications of sepsis resulting from the wound. It is, as a rule, unwise to hide behind a diagnosis of tuberculosis or malaria when the patient does badly after a surgical procedure. It is important that surgical sepsis should first be excluded, and not till then may it be permitted to explain matters on some other ground. Malaria is a particularly convenient fool's paradise which accounts most agreeably for fever, chills, and nearly all the dread symptoms of early sepsis. It is bad enough for the surgeon to diagnose malaria without the discovery of the plasmodium in the blood, but when he actually treats his patient with quinine, and omits the careful and painstaking examination of every part of the wound for local infection, and of every part of the patient himself for metastases or other signs of general infection, the case is infinitely worse. It is not the pet theory of the surgeon which will get the patient out of his trouble, but the careful observation and weighing of facts.

Indications for Change of Dressing.— Clean wounds should not be disturbed without cause, for any motion of the injured parts tends to delay union. Change of dressing and inspection of the wound is necessary under the following circumstances: when there is increasing pain, especially in cases where there is not supposed to be abnormal tension; in the event of the occurrence of a chill, except the post-operative rigor; if there is sudden elevation of temperature; if there is recurrent hemorrhage; when the dressings are soiled by the discharges from the wound. A little spot of discharge appearing upon the bandage in the case of an aseptic wound is not necessarily an indication that the entire dressing must be changed. The spot may be covered by a piece of aseptic

gauze, which should be bandaged or pinned in position. The danger is that such spots, indicating as they do the existence of a decomposable tract between the outer air and the wound itself, might become the starting-points of infection.

Recurrent hemorrhage demands immediate inspection of the wound. It may be of two varieties, the concealed, or internal, and the external hemorrhage. The external variety may be recognized by the appearance of coagulating blood outside the bandages. If it is known that no spurting vessel has been cut, the effect of pressure by means of a firm bandage applied outside the entire dressing may be tried. If this does no good, the dressings must be removed and the wound examined, removing sutures as well if the case seems to warrant it. A spurting vessel which may have been overlooked at the time of operation may now be secured by forceps or suture, while if there seems to be a general oozing, very hot water, as hot as the hand can bear it, applied with some pressure, will probably check the bleeding. As a rule, hemorrhage which at first looks like general oozing may be traced to some little artery. Repeated and rapid sponging will usually permit one to detect the orifice of the bleeding vessel. General oozing is nearly always confined to wounds of glandular structures or to individuals who are afflicted with hemophilia. The application of normal blood or of a five per cent. gelatine solution to bleeding surfaces will in many instances cause coagulation where other means have failed. The gelatine solution can be easily prepared and need not be accurate in its proportions.

Concealed or internal hemorrhage is recognized by the rather sudden and progressively deep collapse, the restlessness, the deep sighing respiration, the nausea, the pallor, the rapid, weak, and irregular pulse, and some elevation of temperature; later the patient complains of the darkness of the room, the pupils dilate, and after convulsive movements there is syncope and death. When an individual has suddenly lost a large amount of blood from any cause, the collapse should be treated and saline infusion practised. It

must not be forgotten that, where the bleeding is not extremely rapid, but is nevertheless constant, the collapse and syncope may act in a salutary fashion by lessening blood pressure and permitting coagulation.

Infection : Partial Wound Infection. — Occasionally small areas show a red blush, indicating that an infection of some kind has occurred and that it probably does not involve the entire wound. The removal of a stitch or two at the points where the redness or swelling appears will then, perhaps, allow of the escape of a drop or more of fluid, purulent or not. This means that the affected portion of the wound should be opened, washed out, packed, and redressed wet. Little points of infection often occur around improperly prepared sutures. They are more common when catgut has been used or when silk sutures have been deeply placed so that they embrace considerable tissue. If looked after at once they are not liable to cause serious complication, but if they are not attended to early, there is retention under the dry dressing, and the infection is very apt to spread to the deeper parts so that primary union is prevented. Indeed, in some instances the value of the operation as a curative measure is seriously impaired by infection of this kind, as is the case when stitch abscess occurs after the operation of herniotomy. Though there may be few if any constitutional symptoms to indicate the presence of stitch abscess, there is usually a slight but constant elevation of the temperature persisting after the first rise following the operation. This initial rise is fairly constant after any operation of magnitude and has been variously accounted for, the most plausible theory being that it is due to the absorption of certain constituents of the blood and serum by the wounded surfaces.

Local and General Infection. — It is not always easy to distinguish between a local and a general infection, though a well-marked general sepsis presents such characteristic features that it is easy enough to recognize. As already stated, there is usually more or less constitutional disturbance in every case of local infection, but

as long as the general symptoms depend entirely on the presence of the local trouble, it should not, properly speaking, be called a case of general sepsis. When, however, the system is poisoned by living germs, or their poisonous products, to such an extent that even should the source of the vitiation be removed there would still remain enough poison in the system to cause symptoms of constitutional infection, we may call the case one of general sepsis. This test of the actual removal of the contaminating source is not always feasible, so the diagnosis has to be made in most instances on other evidence.

Local, as well as general sepsis, varies in its symptoms and course between great extremes according to the quality of the infection and individual susceptibility. There may be an acute destructive inflammation accompanied by great pain and severe prostration, with the result, after only a few hours, of lasting damage to the infected parts; or there may be a mild, slowly spreading invasion of sepsis, with the indolent formation, after several days, of a few drops of pus, with hardly any constitutional symptoms, and with so little tissue destruction that when the wound has healed the scar can hardly be distinguished from one which has followed aseptic union. On account of this great difference in the types of infection it will be best to describe the mild and virulent forms separately.

Mild Wound Infection. — The first sign of a mild local wound infection is usually pain and tenderness. In cases where the infection does not cause marked tension, however, the symptom of pain may be a late one, or it may be wanting altogether. Such is the fact in most cases of urethral and puerperal sepsis. There is always some elevation of the temperature, varying in degree with the virulence of the infection. The pulse rate, too, becomes more rapid. After an operation which was supposed to be aseptic, a rectal temperature, varying between $99\frac{1}{2}^{\circ}$ and 101° , continuing for a number of days, should, in the absence of other signs, be considered as highly significant of mild wound infection. The absence

of tension and the deep starting-point of the infection may account for the fact that there is no pain, local redness, or visible swelling. In the operation for the radical cure of hernia, for example, there are several layers of sutures. It is quite possible that a mild infection, starting from one of the deeper stitches or from a ligature, may be hidden for a number of days, the patient feeling quite comfortable, and the exterior of the wound healing by primary adhesion, so that a careless observer might be inclined to believe that all was well. The progress of the infection, slow at first, becomes more rapid in a sort of geometrical progression, until there seems to be a sudden exacerbation, the temperature becoming suddenly higher and the pulse more rapid, redness and swelling appearing at the site of the wound, and the patient perhaps experiencing a chill. The appearance of the case may even be changed to that of acute general sepsis. If the wound be now reopened, the pus evacuated, and a packing and wet dressing applied, the course of healing becomes once more smooth. Infected wounds of this variety require daily change of dressings until, after a week or ten days, granulation has become established, when they may remain undisturbed under dry dressings for two or three days at a time.

Acute Infection. — An acute wound infection is ushered in by severe symptoms. Pain is usually, though not constantly, present. It should be regarded as of importance when we are sure that there is no tension in the wound to account for it. The patient feels much prostrated, his expression is anxious, there is loss of appetite, a dry tongue, chilly sensations or even a frank chill, the pulse and respiration are quickened, and the temperature rises rapidly. The whole aspect of the individual is one which expresses distress.

On examining the wound it will probably be noted that the region is œdematous and red, while if there are sutures, they seem to have cut into the tissues by reason of the swelling. On removing them and separating the agglutinated edges of the wound, there will probably be an escape of pus, and every suture and ligature will be found embedded in greenish necrotic tissue. Fascia,

tendon, and other fibrous structures look somewhat discolored in patches, which after some days will come away as sloughs. There may be a foul odor from the discharge, especially if the wound is about the mouth, the anus, or the intestinal tract. Sometimes the decomposition has been accompanied by gas formation, and there is a distinct emphysematous crackling on manipulation or even a hissing sound on opening the wound. The lymph-nodes which are in anatomical communication with the region are swollen and tender and are frequently the seat of secondary suppuration. Thus, if the infection is in the hand, the epitrochlear and axillary nodes will be affected; if in the jaw, the cervical chain. Red streaks indicating lymphangitis may be seen running toward these nodes. On palpation the parts will be found exquisitely tender, and on gentle but firm pressure tiny beads of pus will exude from the walls of the wound.

The proper treatment for a case of this sort is to remove, at once, all the sutures, pack the wound with gauze, and apply a large wet dressing ample enough to extend well beyond the swollen lymph-nodes. If pockets of pus have already formed, and it seems difficult to drain them through the original opening, free counter-incisions should be made without delay. A dusting of the painful wounded surfaces with orthoform will contribute much to the comfort of the patient. Dressings should be changed as frequently as is necessary to insure the prompt removal of the poisonous wound discharges. It will be found that the old-fashioned linseed poultice, applied every hour or even oftener, and well covered with a piece of oil-silk in order to preserve the heat and moisture, will prove grateful as a dressing after the packing has been inserted, hastening the separation of the sloughs and rendering the tissues soft and more easily drained. As soon as discharge is free, and the wound begins to "clean off," the poultice may be discarded in favor of the wet dressing. Antisepsis by chemicals is here hardly attainable. Our efforts should be directed toward proper drainage and cleanliness, allowing physiological

antisepsis to accomplish its good work ; for, as is well known, the living animal tissues have a way of their own by which they rid themselves of noxious germs and their products, if mechanical cleanliness is but maintained through the continuous removal of wound secretion from every nook and recess of the infected cavity. Local suppuration then becomes a self-limited process. It was by the observance of this principle, that pre-antiseptic surgery was able to accomplish what it did, and though the teachings of the modern school form a great advance on those of other times, yet the improvement is noted principally in the prevention of infection as well as in more intelligent treatment from knowledge of its causes.



FIG. 55.— Proper shape of probe for exploring sinuous tracts. The position of the proximal end indicates that of the distal.



FIG. 56.— Application of principle illustrated in Fig. 55.

The teachings of the older surgeons, though the result of empiricism, contain much that is good which need not always be discarded for newer methods, but which may form a solid foundation on which to build a more artistic superstructure.

When deep cavities due to the burrowing of the pus exist in connection with the wound itself, it may not always be necessary to drain

them by incisions. They should be carefully explored with a large-buttoned probe, and then drained by inserting a rubber tube,

washing out the cavity and cleansing the tube as often as the accumulation of discharge makes it necessary. It is in the treatment of septic cavities of this kind that antiseptic irrigations are often of use. A daily flushing out of the space with a three per cent. solution of carbolic acid, a one per cent. solution of lysol, or some similar disinfectant, will diminish the pus formation and hasten the cure. It is not wise to allow any of the solution to remain in the cavity, however, so the antiseptic irrigation should be immediately followed by a washing with some mild, cleansing lotion, such as normal saline solution. Should the pus show a tendency to form pockets which are difficult to drain by tube, they may sometimes be reached by other incisions which will allow of easier drainage from a lower point or one much nearer the surface. (Fig. 37.)

Considerable pain and some fever are to be expected in cases of acute local infection, until the sloughs begin to come away, which will be in from four to ten days after the invasion. This is because absorption goes on under the necrotic areas. It is not advisable, however, to cut away sloughing tissue too soon, unless, indeed, the entire infected region can be removed at one time. Thus, while the amputation of a locally infected part may cause the immediate subsidence of symptoms of sepsis, the mere manipulation of infected regions accompanied by bleeding may be responsible for an aggravation of the trouble, or even for a general sepsis, from the entrance of pathogenic germs into the opened vessels. It is also right to observe cleanliness in the manipulation of the filthiest wounds, for one may never know when a new element of infection is introduced during a dressing, and this new germ may be more virulent or fatal than the one causing the original sepsis. To illustrate, erysipelas may be engrafted upon an ordinary pyogenic infection. When the wound "cleans up" by the casting off of the necrotic parts, the flow of pus becomes more profuse, but the constitutional disturbance becomes much less, the pain and fever diminishing or disappearing, and the appetite returning. The pro-

cess of healing by granulation now goes on with little or no general disturbance, so long as drainage and cleanliness are observed. Wet dressings are apt after a time to cause maceration of the skin and flabbiness of the granulations, so when the discharge has diminished and repair is progressing, dry applications will be found to be more stimulating, particularly to the formation of epidermis. Where the granulating areas are very extensive, an oily dressing made of ten per cent. balsam of Peru in some bland oily substance, such as castor-oil, vaseline, or lanolin, plentifully spread upon gauze or lint, and covered with gutta-percha tissue or oil-silk will be found an excellent application which is neither "wet" nor "dry." Dry dressings in suppurating wounds should never remain unchanged for more than forty-eight hours, and usually not so long, for the discharges form a sort of crust under which retention is apt to take place.

Secondary Hemorrhage. — It is at the time of the sloughing off of the necrosed tissues that secondary hemorrhage is apt to occur. It is due to the necrosis of a portion of the wall of an artery. When the slough of the vessel wall is cast off, the hemorrhage begins. It should be feared whenever a suppurative infection exists in the neighborhood of a large blood-vessel, especially if an artery of considerable size has been ligated. Until all the sloughing is over, the patient should be where he may command the instant presence of the surgeon. Secondary hemorrhage is rare after the sixteenth day.

General Treatment in Local Infection. — During the progress of a local infection it is important that the patient should be kept well nourished and that the bowels should move daily. The food should consist of fluids, taken a little at a time, but frequently. Since suppuration is very apt to occur in cases of glycosuria, the urine should be examined for sugar as well as for albumin, the diet being modified according to the results of analysis.

Grave local sepsis is occasionally the source of general toxæmia which may present all the symptoms of acute general infection by

living germs even to the fatal termination. Yet, when it is possible actually to remove the contaminating part, the general symptoms subside and a rapid recovery follows, provided that a fatal dose of the toxine has not already been absorbed. When, therefore, we are treating a patient who is profoundly septic, depending on what seems to be a local infection, the rational procedure, after the failure of other therapy, is to remove the diseased focus. The amputation of a leg for the relief of sepsis due to an acute suppuration of the ankle is justifiable, whether we deem the joint irreparably damaged or not, whenever the patient's vital condition becomes dangerously impaired. To determine this question requires the most conscientious reasoning and acute observation on the part of the surgeon. All possible skill and the fruits of past experience must be brought into play, for the responsibility cannot be shirked.

Septicæmia. — General or systemic sepsis, better known as septicæmia, is now, fortunately, of infrequent occurrence as a result of surgical operation. The condition is more commonly encountered as a disease accidentally acquired. Its distinguishing feature is the presence of living pathogenic microbes, as well as their poisons, in the circulating blood of the patient. This fact can be demonstrated by taking cultures from the veins of the subject, but it is sometimes forced upon us when what are known as metastatic abscesses appear. These abscesses are caused by bacteria, which are deposited from the blood in various tissues of the body remote from the point of original infection. The disadvantages of the blood test by culture are that a bacteriological laboratory may not be easily reached, and, more important, that the development of the bacteria in the culture tube may be a matter of several days. Indeed, the result of this examination may not be known until the fate of the patient has been decided.

The onset of acute general sepsis may present so many and such various combinations of phenomena that it is difficult to give a description of the clinical features of the early stages of the dis-

order which shall cover its many aspects; and yet, it is on the clinical picture of the disease that our working diagnosis depends. When the malady has progressed for a time, however, this picture becomes more and more typical, until in the later stages there is no mistaking the condition. In order that our treatment may be of value, it should be instituted early. On the promptness of the physician to recognize the presence of the sepsis, will often depend the success of his ministrations.

Certain variations in the symptoms occur as a consequence of the kind of tissue involved and its anatomical location, the sepsis of acute osteomyelitis and that of peritonitis, for example, differing in some particulars. The different types will be discussed under the headings of the primary diseases. It is true that the more virulent forms of sepsis are usually due to varieties of streptococci, and the milder forms to staphylococci, but since either germ may cause both mild and severe sepsis, it is not necessary to distinguish clinically, in the present state of our knowledge, so far as the treatment is concerned. It is better to divide the infections into the severer and milder types, and of these a general outline will here be given. Both varieties are exceedingly serious complications in any surgical case, and the milder form differs from the severer more in the rate of its progress and the violence of its symptoms than in the danger as to the ultimate result.

The milder form of the disturbance comes on a few hours to several days after a traumatism, surgical or accidental, and generally makes its presence known by an elevation of the temperature and an increasing pulse-rate; frequently accompanied by pain and swelling in the wound and the neighboring lymph-nodes. There is often a chill or chilly sensations, with loss of appetite, nausea or vomiting, dry or coated tongue, a dry skin, thirst, and a feeling of prostration. After the chill the temperature rises, the elevation being followed by a period of sweating associated with a decrease in the body heat. After the appropriate treatment of the wound, which should be our first care when such symptoms arise, there

may be little or no improvement in the general condition of the patient. A few hours later the temperature will again rise, and a cycle of phenomena follows similar to the first. The pyrexia is not excessive for a long period at a time, the thermometer ranging between a maximum of 101° and 103° daily, with an occasional drop to normal or even subnormal. Sleep is disturbed, and there may be profuse nocturnal perspiration. The patient becomes weak, and emaciation is rapid. Albumen usually appears in the urine, together with hyaline and granular casts. It is in this class of sepsis that metastatic foci frequently occur, and careful search for tender or fluctuating spots should be made daily. These abscesses, which often develop with astonishing rapidity, may occur in any of the tissues of the body, being met with in gland, joint, bone, or muscle. They should be evacuated by free incision as soon as possible after they are discovered, and, as they are usually multiple, the search must not be relaxed simply because one focus has been found. The loins should be explored by careful palpation, for it sometimes happens that large collections of pus form here in the retro-peritoneal or perinephric regions, which are for some time quite painless and thus elude detection. If instead of fluctuation an indurated point is found, it may be poulticed for from six hours to one or two days, when fluctuation will probably appear and the abscess may be opened. Long-continued poulticing is not advisable while the pus is confined. The strength of the patient must be kept up by judicious feeding and stimulation. Free diuresis should also be striven for with the aid of copious draughts of water at the room temperature, not iced or chilled, and with diuretic antiseptic drugs, such as urotropine. Salicylic acid in some form will sometimes be found of benefit as an internal antiseptic, the oil of wintergreen (gaultheria) being an agreeable form of administration for most individuals. The care of the mouth should not be neglected, for during septic illness it is apt to become dry and foul. A tooth-brush should be used every two hours with peppermint water and bicarbonate of soda as a dentifrice. The

bowels should be moved soon after the onset of septic symptoms, and for this purpose calomel followed by a saline is recommended. Later, the daily administration of some mild laxative is advisable, with an occasional enema when the drug has not operated sufficiently. In fact, all the natural avenues of escape should be kept clear, so that the toxins may be eliminated from the body with all possible speed.

Acute General Sepsis. — This frightful complication, which may follow the most trivial wounds or surgical procedures, depends not only upon the entrance of particularly virulent germs into the system, but also, probably, upon a susceptibility on the part of the individual. There is usually a chill, or, if the patient is a child, a convulsion, and this is followed by a rapid rise of the temperature, the thermometer not infrequently registering 105°, 106°, or even a still greater degree of body heat. There is also a quickening of the pulse-rate and the respiration. Following this, there is somnolence or stupor more or less pronounced, gradually running into a state of delirium. Occasionally the delirium is present without the previous stupor, or the patient may insist that he feels perfectly well, in spite of the fact that he has a temperature of 106 degrees and that his heart is irregular in its action and beating 120 times to the minute. In fact, he is sometimes even jocular, sadly belying his objective signs of distress. This peculiar state is in reality a form of incipient toxæmic delirium, the more classic signs being apt to follow soon. Vomiting is frequently observed, more especially in children. Within a few hours a distinct yellow cast will be noted in the skin and conjunctivæ, due not so much to hepatic disturbance as to changes in the blood. Albumen and granular casts will be found in the rather scanty and high-colored urine. Sometimes there is at first albumin without casts, the renal elements appearing later, especially if the patient improves and the kidneys are beginning to act more freely. Constipation is a quite constant symptom, and in the severer forms of sepsis efforts to induce catharsis by drugs are often complete failures. The patient cannot

easily be made to take food, and when the nourishment is given by force it is usually vomited. Even rectal alimentation is frequently of little or no assistance, because the food is not absorbed, but is expelled after a time, altered little or not at all. Naturally, under these circumstances, the patient rapidly emaciates, becoming weaker and weaker until he dies of exhaustion, if he does not succumb earlier to the poisoning of some vital centre.

If, by careful nursing and stimulation, life can be prolonged for a time, the dangers of the septic involvement of the various vital organs must be watched for and combated. The heart, the pericardium, the lungs and the pleura, the peritoneum, the coverings of the brain and spinal cord, and, in fact, any important organ of the body, may become inflamed and threaten the patient's life with a new danger, as much to be dreaded as the old. Complications like these often appear with remarkable rapidity, the rough, back-and-forth burr of pericarditis being plainly heard only an hour or two after a negative auscultation.

The evil symptoms persist, remissions occasionally giving hope, only to be followed by other chills and further signs of evil significance. Metastatic abscesses are not commonly found in sepsis of this type, because the patient seldom lives long enough for them to develop sufficiently to be palpable. They are not frequent before the fourth or fifth day, and usually appear still later.

During the progress of the disease the wound, which was originally the source of infection, may do very well if the drainage and other treatment have been what they should be, whereas in septic intoxication without the presence of germs in the blood, the wound is itself the source of the blood-poisoning, and improvement in its condition is followed by amelioration in the symptoms. It must be remembered that septic wounds may give rise to the most severe toxæmia, even though there is no living blood-poison. The simple passing of a catheter through an unclean urethra may cause the absorption, through an abrasion of the mucous membrane, of a dose of toxine sufficient to kill within a few hours. If the dose has

not been a fatal one, the patient rapidly recovers from his chill and is as well as ever, while if living germs have entered the blood, general sepsis will more gradually develop, the case becoming desperate. It is true, also, that the germs and the virulent dose of toxine may enter coincidentally, and then a remission may succeed the acute onset, to be in its turn followed by the progressive signs of grave bacterial blood-poisoning.

Treatment.— Acute general sepsis is, probably, a self-limited disease, provided we can keep the patient alive long enough. There is at present no specific remedy known, although serum-therapy and treatment by alkaloidal antidotes may, in the future, give humanity this boon. As things are at present, however, we are able to do little more than make the diagnosis, and treat the symptoms as they arise.

Sepsis is a most complex condition. It is often composed, indeed, of a number of coincident diseases, as when it begins with an osteomyelitis as a focus and then involves various organs, so that in the course of the trouble we may be obliged to treat pneumonia, pericarditis, pleurisy, abscess of the kidney, meningitis; in fact, disease of any organ or portion of the body. And since the onset of these complicating disorders is often extremely rapid, it demands the most constant watchfulness and care to recognize their existence before they have advanced to the danger limit.

To give the treatment of the various forms which this horrible malady may assume would far pass the bounds of any work on surgery. The important thing to remember is that these cases are not absolutely hopeless, though they are undoubtedly most desperate, and that it is our duty to keep the patient alive as long as we can with nourishment and stimulation, and to do all in our power to get rid of the toxins by the natural channels of elimination. Here we have a double difficulty; for the absorbing and assimilating functions are deranged, while the organs of elimination, especially the kidneys, are commonly diseased and not doing their part of the work properly. Milk, plain or peptonized, fer-

mented or with lime-water, taken not too cold, a little at a time and very often, is the sheet anchor in the way of food. If it is impossible to feed the patient by mouth, and absorption by the rectum is insufficient, feeding by the stomach tube may be attempted. At times, however, this valuable method cannot be employed, especially in the case of patients who are delirious, because their struggles are too exhausting for their safety. We may then fall back upon daily inunctions of the entire surface of the body with lanolin or cod-liver oil.

The various meat preparations which contain albumen, such as meat juice obtained by expression, may be well borne, but when there is renal derangement these must be given with due caution or not at all.

To relieve the distress occasioned by a chill, forty to fifty minims of chloroform may be given by mouth with the result that the chill is very likely to be cut short. The patient must be told that the chloroform will strangle him for a moment, and that it must be swallowed in one gulp, to insure its passing into the stomach with the least discomfort. It may be followed by a swallow of water.

Convulsions in children, due to the sudden invasion of an acute sepsis, may be mild in character, lasting but a few moments, or they may be prolonged, and severe enough to cause death. But little can be done to mitigate their violence, unless the convulsive state persists for a long time, when the administration of chloroform by inhalation may be employed with the prospect of temporary relief. There is grave danger to the patient's life during a convulsion of this kind, and, in the event of a fatal termination, the friends of the patient, especially if they are ignorant persons, will be likely to blame the surgeon for having administered the anæsthetic. With the exception of cold to the head, little if anything else should be attempted. It is doubtful if the usual hot bath during the attack does any good whatever. As soon as the convulsion is over, the lower bowel should be emptied by enema.

Constipation, due to loss of intestinal tone and reflex excitability, is quite a frequent symptom. Catharsis by calomel and salines is a great aid in getting rid of the toxins, but frequently the response to efforts in this direction is far from satisfactory, and we are obliged to depend upon enemata to keep the rectum and lower bowel clean. The calomel may be given in one-grain doses every hour for from three to five hours, and the sulphate of magnesia, a drachm at a time, also every hour, the first dose being given a half-hour after the first dose of calomel, so that calomel and salts are taken alternately every half-hour. If the medicine is vomited, it is best to postpone for a time other attempts to move the bowels except by enema.

High temperature in itself is not usually a genuine danger. So far as possible, it is best to treat this symptom without drugs, depending on general refrigeration by sponge baths to bring the temperature down to the limit of comparative comfort. If the hyperpyrexia is of an excessive character, however, and does not yield to the baths, antipyrin, in doses of ten grains combined with an alcoholic stimulant and not repeated oftener than once in four hours, will be found, on the whole, to be the most reliable of the modern antipyretics. This drug should not be prescribed together with calomel or with spirits of nitrous ether. If the treatment is to be long continued, it is best to change for a time to acetanilid in doses of from three to five grains, or to phenacetine in ten-grain doses. Most of the coal-tar antipyretic preparations have the reputation for causing cyanosis, so a stimulant should be coincidentally given. As a rule, too much attention is paid to the temperature as in itself a source of danger, while in reality it is seldom high enough to be threatening, and is a useful sign by which we may estimate the course which the disease is taking.

Delirium is one of the most sinister omens in acute sepsis, and one of the most difficult conditions to treat. It comes on in the very cases where stimulation is, for other reasons, indicated, and yet stimulation is very liable to aggravate the disturbance of the

sensorium. An ice bag or ice cap to the head is often soothing, and, unless the delirium is of a particularly violent character, wet packs will frequently persuade slumber.

These wet packs need not be very cold. It is but necessary to envelop the patient in a sheet lightly wrung out in lukewarm water, and then to cover him with a second sheet if the room is sufficiently warm, or with a blanket if the room cannot be well heated. After the first few moments the feeling of discomfort passes, and a state of quiet ensues, often followed by sleep. Morphine should be reserved until there is actual danger that the patient may die of exhaustion, or that his active movements may jeopardize his life through some accident at the wound, such, for example, as the straining out of intestine from an abdominal incision.

Diuresis, when the urine is scanty and albuminous, is of extreme importance. Digitalis alternating with small doses of calomel acts particularly well. The tincture of digitalis may be given in doses of ten to fifteen minims every four hours, and the calomel in tablet-triturations, a quarter of a grain each, every two hours, unless too frequent catharsis is induced. Urotropine in doses of ten to twenty grains once a day will also act as an efficient diuretic, and is a urinary antiseptic as well. At the same time the patient should be encouraged to take as much water as he will, not iced, but at the room temperature, and this may be made to alternate with milk, itself a good diuretic as well as a food. When suppression is threatened, dry cupping over the kidneys is to be advised, and, as a last resort, saline infusion into the rectum or even into the veins. (See Chapter IV.)

When weakness of the heart is indicated by a feeble, rapid, and irregular pulse with a weak or inaudible second sound, digitalis and strophanthus may be used alternately. Ten minims of the tincture of digitalis may be given hypodermically every four hours, and five minims of the tincture of strophanthus also every four hours, so that the patient shall receive his stimulation every two hours. If

there is sudden depression or heart-failure, the nitrate or sulphate of strychnine may be given as an additional stimulant, the usual stimulating dose being the twentieth of a grain, which may be repeated in half an hour unless twitching of the muscles or other indication of increase in the reflex excitability suggests that the physiological limit has been reached.

The rapidly appearing endocarditis or pericarditis may be intelligently combated with the aid of local refrigeration, an ice bag to the precordial region being of distinct value.

CHAPTER VI

SPECIAL FORMS OF INFECTION

Erysipelas. — Certain forms of wound infection are sufficiently typical to warrant special description and discussion. The first of these is erysipelas, an acute inflammation of the skin or mucous membranes, with infection of the lymph-channels. It is due to the presence of one form of the organism known as streptococcus, which develops with great speed and malignancy, the disease appearing within a few hours of the infection. The germ invariably gains entrance through a wound, even though this be so small that it has escaped notice, and the disease, characterized by œdema and redness of the skin, begins at this point of entrance. The patches of redness are pretty sharply defined, and spread rapidly. Patients afflicted with the disorder may show other patches of the inflammation at a distance from the initial site of the trouble, probably in consequence of secondary infection. There is always considerable constitutional disturbance with an attack of erysipelas, beginning with a chill or a sharp rise in the temperature, prostration, and often nausea and vomiting. When the disease appears about a suppurating wound, one of the striking features is the cessation of the discharge, which, instead of continuing as pus, becomes a scanty serous exudation. The healing process is arrested, not to be resumed until the attack has subsided. The progress of the erysipelas is practically the same as that of an acute general sepsis, varying in virulence according to the activity of the invading germs and the resisting power of the individual, and gradually abating if the case is to result favorably. With the disappearance of the local

inflammation there is epidermal desquamation. Relapses are far from infrequent, and should be guarded against by scrupulous care at each dressing, and at all manipulations about the wound.

Treatment. — The general treatment of erysipelas should be very much the same as that of acute sepsis, *i.e.*, nutrition and stimulation to tide the patient over the dangerous period. (See Chapter V.)

Locally, a solution of ichthyol in collodion, from ten to twenty per cent., may be painted upon the reddened areas, while a girdle of mercurial plaster about an inch wide should surround the patch. If the disease is confined to one of the extremities, this belt of plaster should surround the limb at a point above the infection. If no ichthyol-collodion is to be had, a wet dressing of the acetate of aluminium solution should envelop the entire affected part. (See p. 12.)

The greatest caution should be observed, while the surgeon is treating a case of erysipelas, that the disease may not be carried to the wounds of other patients. A covering of some kind, such as a linen duster or a clean night-shirt, should be worn over the street clothing, and should be kept at the house of the patient, to be donned whenever the sick room is entered. The surgeon's hands should be thoroughly washed and disinfected when the dressing is finished, and, in the event of his being called to perform other surgical work, antiseptic precautions must be redoubled. If rubber gloves can be procured, they should be used in all manipulations about the infected wound, and in spite of this the washing and disinfection of the hands should be carried out as if no such protection existed.

Phlegmon. — When acute infectious inflammation takes place in the cellular tissues, dissecting the structures away from each other, and spreading rapidly along the lines of the least resistance, the condition is called phlegmonous. It is frequently caused by streptococci, though not necessarily the same variety which is looked upon as the bacillus of erysipelas. The disease is sometimes spoken of under the name of suppurative cellulitis. The process

is usually an intensely virulent one, causing great destruction of tissue and the formation of much pus. Clinically the disease is recognized by an acute onset with great pain, tenderness, and swelling, with infection of the neighboring lymph channels and nodes. Redness or duskiness of the skin appears when the inflammation is near the surface. Fever, prostration, and the usual signs of septic infection also mark the progress of the malady.

Treatment. — The treatment of phlegmon is comprised in one word, *drainage*. A sufficient number of incisions must be made to admit of thoroughly emptying every recess, and a careful watch must be kept for the formation of other cavities, for the pus will burrow in any direction between the fasciæ. According to the size and conformation of the suppurating area the drains must be of tubing or of gauze or other absorbent material. When the infection is in a part of the body where the appearance of cicatrices is a matter of indifference, the incisions should be ample, and gauze packing should be the method of choice in accomplishing drainage; while if the disease affects exposed parts, the incisions may be smaller and more numerous, drainage by tube being then required. In deciding where the openings should be made, it is well to make the first cut at the most prominent part of the phlegmon, and to explore the depths with the finger, or with a blunt instrument, such as a large-headed probe, which should be pushed into the cavity to a distant point, and then turned so that its extremity may be palpated through the skin. Here the end of the instrument may be cut down upon, and pushed completely through, the counter-opening being thus made. Starting at this point, it may be possible to discover other recesses which must be opened in the same way. It is not always as easy as one might think to insert a drainage tube or a gauze fillet into such an opening, so it is best to fasten the drain by tying it to the probe on its emergence, so that it shall follow the instrument on its withdrawal. If the phlegmon affects an extremity, the operation may be rendered much easier by the application of a rubber constrictor above the diseased

area, so that hemorrhage may not obscure the field. In this way the pus channels may be quite easily followed up and thorough work performed. Most of the redness or duskiess disappears within a few moments after the operation. When this is not the case, erysipelas should be suspected.

It is necessary to apply soaking wet dressings after these operations, and daily irrigations should be practised, in order that the infectious discharge may be removed as expeditiously as possible. Indeed, when the suppuration is very profuse, it is best to change the dressings more than once a day. Sloughing tissues must be removed as soon as they are detached. When the wound secretion becomes serous or viscid, convalescence may be recognized, but it must be understood that retention of secretions at any point will cause an exacerbation of the symptoms, and, in fact, a kind of relapse of the original trouble. When an opening persistently refuses to heal after an operation for phlegmon, there is probably a piece of dead tissue at the bottom of the sinus.

Abscess.— An abscess is a circumscribed collection of pus in the tissues of the body, limited by a wall of inflammatory tissue. It becomes larger and larger and tends to rupture through the skin or into one of the cavities or spaces of the body. When the pus breaks through its confining wall into one of the natural cavities, it infects the lining membrane, causing disturbance more or less grave according to the importance of the part invaded and the virulence of the infecting pus. If the abscess breaks into the inter-fascial or inter-muscular spaces, it becomes a phlegmon.

There are various germs which may be the cause of abscess, the most common forms being those known as staphylococci. They are found in groups or clusters, and not in chains like the streptococci.

The presence of an abscess is recognized by the appearance of a localized swelling, which is at first hard and brawny, becoming softer and fluctuant as its size increases. Redness of the skin appears when the pus approaches the surface, but unless the abscess

is very superficial from the start, the condition should be recognized without this sign. Abscesses are nearly all very painful and tender, the exceptions being certain chronic varieties usually due to tuberculosis. The pain of an acute abscess is of a dull, throbbing character, and it is accompanied by constitutional disturbance, such as chill, fever, loss of appetite, and other indications of septic absorption. The pain is in proportion to the density of the inflamed tissue, and depends also upon the anatomical location of the pus. Thus, a bone abscess causes far more acute symptoms than suppuration in a lymph-node, and an abscess of a part which is well supplied with sensitive nerves is more painful than one where these nerves are comparatively few. As examples may be mentioned the intense agony of infections at the finger tips and the duller pain of ischio-rectal suppuration. When an abscess approaches the surface, and by the œdema of the skin and the superficial fluctuation, shows signs that it will open, it is said to be pointing.

Treatment. — Abscesses, especially of the acute variety, are to be treated by evacuation and drainage at the earliest possible moment after the diagnosis is made. If the process is superficial, ample incision with a scalpel will be sufficient; but when the collection of pus is at some distance from the healthy surface, its safe evacuation becomes more of a problem. A careful dissection should be made down to the abscess wall and then, after covering important uninfected tissues with gauze to protect them from contact with the pus, an aspirating needle attached to the syringe should be plunged into the abscess. Having ascertained by drawing the piston that we have entered the pus cavity, a grooved director or some similar instrument is forced in alongside of the needle. The closed blades of a slender dressing-forceps may now be inserted along the director and then separated, at the same time withdrawing the instrument. The abscess wall is thus torn by blunt force, and there is comparatively little hemorrhage, while the opening can be made any desired size. Drainage should be se-

cured by two tubes, one of which should be fenestrated at the end alone, while the other has openings along its entire length. Irrigation should be practised through the tube having the openings at its end so as to insure the fluid's reaching the cavity, the return flow being through the other tube. (Fig. 57.) The first dressings may be dry, especially if there is much oozing, but the later ones should be wet. Abscess of various regions will be spoken of in the chapters on Regional Surgery.



FIG. 57.— The arrows indicate the course of the irrigating fluid.

Furuncle. — A furuncle or boil is a local inflammation of the skin, nearly always beginning around a hair follicle, and terminating in suppuration with the casting off of a necrotic plug. Boils are commonest where the skin is thick, the circulation sluggish, and, naturally, where there is a growth of hair. The back of the neck, the back, the nates, the ulnar portion of the forearms, and the nostrils are the parts most generally affected. Staphylococci commonly cause the infection, and the microbes are often carried by the hands to comparatively distant parts of the body, while the neighborhood of the original infection becomes almost invariably the seat of a crop of boils. There is considerable local pain and some constitutional disturbance with the infection. The lymph-nodes in the neighborhood are enlarged and tender, and there is often considerable oedema of the surrounding tissues.

The appearance of a furuncle is that of a red, angry-looking conical elevation with a pustular point at its apex. On gentle pressure there is pain, and if the epidermis at the apex has been removed, a drop of pus or sero-sanguinolent fluid exudes. If the furuncle is quite well developed, there may be a little crater-like

opening at the top through which the slough may be seen and, if it is not too large, expressed.

Treatment. — When a furuncle develops with great rapidity, or when, in spite of the usual little crater which has formed, the opening is insufficient, incision is the proper treatment. The region about the furuncle should be shaved, using the razor in the direction of the crater and not away from it, so that infection may not be spread to healthy parts. Care should be observed, too, that when the incision has been made, none of the discharge shall be smeared over the surrounding skin. Indeed, where the patient has shown a tendency to furunculosis, a coating of vaseline or zinc ointment should be spread upon the skin before making the incision. The injection, with a fine needle, of a minim or two of the eucaine solution along the line of the proposed cut will render the little operation painless, while the insertion into the wound of a strip of gauze impregnated with orthoform will prevent the subsequent pain and soreness. A crucial opening well beyond the limits of the necrotic plug will usually suffice.

The first dressing after the incision of a furuncle should be wet, the acetate of aluminium solution being well suited to the purpose. When the slough has come away, a dry dressing will hasten the healing. A patient having shown a tendency to furunculosis should receive general as well as local attention. The bowels should be regulated, the nutrition improved, and the urine carefully examined especially as to the presence of sugar. It is supposed that furuncles are caused by the infection of hair-follicles already irritated by the presence of some toxic substance, which in a perfectly healthy organism should be eliminated by the skin and kidneys. Mono-sulphide of calcium, perhaps because of its elimination by the skin, has been found of value in preventing recurrence of the trouble as well as in favorably modifying its course. The dose is from a quarter to a half grain four times a day, and it should be used for a number of weeks after the disappearance of the boils.

Carbuncle. — The importance of this infection is frequently unrecognized until the disease has assumed truly alarming proportions. It occurs, more commonly, in the old and in individuals who are broken in health. Men are oftener affected than women. Its onset is marked by chill, fever, and other signs of septic infection, together with the appearance of a hard, somewhat elevated, red or dusky swelling at one of the locations where furuncle might be expected. The induration gradually spreads, the tissues becoming brawny at first and later softening over a considerable area, where gangrene of the skin takes place with the formation of numerous openings, which discharge pus, and through which sloughing tissue may be seen. The pain and tenderness are not as great as would be supposed from comparison with the furuncle, but the constitutional symptoms are much severer, the patient rapidly deteriorating in strength and general condition, until he passes into a septic state more or less profound, often terminating in death.

The necrosis may be quite extensive, taking in the skin, the subcutaneous tissue, and even the muscles, fasciæ, and other structures.

Treatment. — This must be by the immediate and thorough removal of the septic focus wherever possible. (See carbuncle of the lip, Chapter VII.) The patient should be fully anæsthetized. The instruments required are a sharp scalpel, a stout pair of scissors, a stout mousetooth-forceps, several artery-forceps, besides ligatures, sponges, and the dressings. Strips of gauze should be prepared to be used as tampons to stop the bleeding, which is often very considerable. An anæsthetist and at least one other assistant will be required. As soon as the patient is narcotized, the region should be washed and shaved, but not scrubbed with a brush. If the carbuncle is not too large, the entire diseased area may be excised with a circular sweep of the knife. Very large carbuncles cannot thus be removed, and so the operation must be modified. With the scalpel a free excision of the sloughing tissues should be made by means of a circular cut through the brawny infiltrated portions down to the healthy structures beneath, the assistant packing the

cavity as soon as he can after the removal of the slough. Since the necrotic portion is of an irregular shape, it is probable that there will be more sloughing tissue at the periphery of this first incision. Other incisions should then be made radiating from the first circular one to such a distance as may be necessary to make sure that perfectly healthy tissue has been reached. Each incision must be packed by the assistant as soon as it is made, and unless a really very important vessel has been divided, it is not necessary to secure the bleeding points with forceps. The larger masses of necrotic tissue may be cut away, but as long as the radiating incisions have extended into healthy tissues throughout their *entire depth*, ending in the healthy skin, there is little probability that the disease will not be checked. On account of the hemorrhage it is best to make pressure over the wound for some minutes, and then to apply a firm, dry dressing for several hours, when it may be removed down to the packings, and a wet one substituted. The packings should be removed in forty-eight hours, and the wound carefully explored, gentle pressure being used at the edges in order to ascertain whether there is pocketing at any point. All recesses should be packed and the wound again dressed wet. If at any time pockets form which cannot well be drained from the original opening, counter incisions should be made without delay, for unless it has been possible actually to remove every bit of the disease at the time of the operation, the sloughing process may extend and the sepsis continue. As a rule, the operative procedure is at once followed by the abatement of the symptoms, even the pain disappearing. To be sure, an enormous granulating wound is left which is slow to heal, and which may even require skin-grafting or some other plastic procedure to hasten its closure, but the sepsis which has jeopardized the life of the patient is in most instances overcome within twenty-four hours after the operation. When the granulating wound no longer shows signs of pocketing, it may be dressed dry or with some oily substance, such as the balsam of Peru and castor-oil mixture.

Malignant Pustule. — This frightfully acute infection is caused by the anthrax bacillus. It is usually contracted by man from contact with diseased animals or the skins of those animals which have died of the disease. The infection is found oftenest in cattle and sheep, and the germ may retain its virulence for a very long time, so that contact with an old and dried skin once harboring the bacilli may cause the appearance of the disease in man. General infection from malignant pustule is ushered in by a chill and great prostration, the patient apparently becoming critically ill immediately. There appears at the same time a small pustule, usually situated upon the hand, arm, or face, surrounded by a large and angry-looking areola of red or dusky indurated tissue. There is rapid infection of the lymphatics, and the general sepsis assumes grave proportions, often terminating in the death of the patient.

Treatment. — The most radical measures are necessary as soon as the diagnosis is made, if we hope to prevent the general infection, and since the making of incisions is associated with the danger of carrying the germs into the blood, it is wisest to excise the entire pustule with the aid of the cautery, remembering that if any infected tissue is left, the immediate general spreading of the poison is to be feared. General stimulation and the nutrition of the patient must be carefully attended to, the lines followed out being those laid down in the chapter on sepsis. At the same time the intense virulency of the infection should be sufficient reason for the exercise of the greatest precautions, in order that the disease may not be transmitted to others, especially those who are in attendance upon the patient. All dressings should be burned, and all discharges from the body carefully disinfected with mercuric bichloride solution one to five hundred.

Acute Osteomyelitis. — This is a disease of childhood and early adult life, though it is not unknown in individuals of riper years. As its name implies, it is an infection of the bone-marrow, but the virus may gain entrance to the system through a wound, often a minute one, at a distance from the bone which forms the seat of

the principal infection. Staphylococci and streptococci are usually the infecting organisms. The disease may appear shortly after an injury to the bone such as a fall or blow, or it may come on without assignable cause. The long bones at or near the epiphyses are the ones oftenest affected, but no bone in the body is immune. The picture of this disease is one not easily forgotten; and yet osteomyelitis is often enough mistaken for acute rheumatism, and on account of delay in instituting the proper measures the patient is permanently crippled or even loses his life.

Symptoms.—The disease begins with pain of a dull, boring character generally near a joint. At first there is no swelling, in fact no objective sign; but later the entire limb shows an increase in girth, with, however, no change in the color of the integument. The pain increases, and the affected part becomes exquisitely tender to the touch, even the gentlest manipulation eliciting expressions of agony and fear. There is severe prostration, with elevation of temperature, often as high as 103° or 104° , with or without a chill. The symptoms of sepsis increase more or less rapidly but steadily, so that within from three to four days most of the classic constitutional signs are present, while the part affected is enormously swollen, the skin being glazed and œdematous, but without redness or duskiness. There are no fluctuating areas. The lymph nodes anatomically connected with the part are swollen, but not very tender. If the disease affects a portion of the bone which is near a joint, some arthritic effusion may be noticed, and all motion of the limb or of the joint is resisted by the patient on account of the excruciating pain. Sometimes two or more foci of disease appear, either simultaneously or in quick succession, in the same bone or in different ones, and then there is still more likelihood that the disease may be mistaken for rheumatism, especially if the multiple foci are at or near joints. The characteristic anxious expression of the septic patient's face, together with the history of the failure of the usual antirrhematic remedies, should be sufficient to put one upon his guard. The presence of albumin and casts in

the urine is another point in the differential diagnosis, which is very frequently overlooked.

The progress of acute osteomyelitis, when proper treatment is delayed, is toward the formation of central abscesses involving more or less of the marrow-canal, and resulting in necrosis of the bone and perforation of the abscess through the cortex, so that the periosteum, already inflamed and thickened, is dissected away from the bone. Later the periosteum is perforated and there forms a phlegmon, often of enormous size, which finally, if the patient survives, perforates the skin. To be sure, one does not often see this course of events where a large bone, such as the femur or the tibia, is involved, but in osteomyelitis of the terminal phalanges the sight is not uncommon; the affected bone being so small that, though the sepsis is often quite severe, the patient, and sometimes, alas! the physician, thinks that he can avoid an operation by the procrastinating poultice. When a large bone is diseased, the symptoms become so grave, that however unwilling he may at first have been, the patient finally seeks surgical aid, and is operated upon before the whole gamut has been run.

Treatment. — In order to reach the septic focus, it is necessary to cut down to the bone by an ample incision, and to chisel into the medullary canal. Nothing less is worth dignifying by the name of scientific therapy. The operation will, of course, require the aid of full anæsthesia, unless the bone involved is a very small and easily accessible one, when local deadening of sensation may in some cases suffice. For operation in a case of osteomyelitis of a large bone, there should be at least two assistants besides the anæsthetist. The instruments required are: A scalpel, a pair of large sharp retractors, a pair of large blunt retractors, six or eight artery-forceps, a pair of scissors, a stout dressing-forceps, a periosteal elevator, a small and a medium sized chisel, a small and a medium sized gouge, a hammer or mallet, a large and a small stoutly made sharp spoon, and a probe. The usual needles, ligatures, sponges, and dressings will also be required, as well as an

elastic constrictor or stout rubber tube to stretch around the limb, to produce artificial anemia.

If the disease affects an arm or a leg, the extremity should be held for a few moments in the vertical position so that it may, to a certain extent, empty itself of blood, and then the rubber constrictor should be applied tightly enough to stop the pulsation of the arteries at the wrist or ankle, the rubber being held in place



FIG. 58. — Applying rubber tube as a constrictor.

by a bandage. (Fig. 58.) In winding the constrictor about the limb, the inclusion of folds of skin between the turns of rubber should be avoided. The part to be operated upon should now be placed in such a position that the incision will come uppermost, and it should be supported upon a firm cushion, which may be improvised by covering several pieces of board, each about an inch thick, a foot wide, and of a length suitable to the purpose, with a layer or two of blanket, covered, in its turn, with towels which have been wet with sublimate solution, one to one thousand. The disinfection may then proceed according to the rules laid down in Chapter III., page 43. After the disinfection, all soiled towels should be removed, and replaced by fresh ones.

The primary incision should be ample, and the dissection should proceed rapidly down to the periosteum, avoiding impor-

tant nerves and vessels. When dealing with disease of the tibia, the incision may be in front where the bone is superficial; when operating upon the femur, it may be through the *fascia lata* along the outer side of the thigh. The humerus may be advantageously reached by an incision along the outer side of the arm, taking care to avoid the musculo-spiral nerve; the ulna through the ulnar portion of the forearm where the bone lies superficially, and the radius by an incision which keeps rather behind than in front of the supinator longus. Wounds about the forearm in general are much less liable to cause troublesome cicatrices when they avoid the flexor aspect of the limb.

Having exposed the periosteum by thorough retraction of the soft parts, this membrane should be incised. It will probably be found thickened and succulent, bearing much the same relation to normal periosteum, so far as thickness and texture are concerned, which an orange peel does to the skin of an apple. If the disease has been attacked early, however, the periosteum may not yet have had time to become thickened, and may seem normal or nearly so, though it is peeled from the bone with abnormal facility. If the infection has proceeded for a long time, or if the disease has been rapid and severe in its progress, pus may be found beneath the periosteum, which has already been dissected away from the bone by the suppuration, and if the case happens to be a neglected one, there may be a phlegmon which will be encountered as soon as the first incision through the skin is made. In any event it is necessary that the medullary canal of the affected bone should be opened, or the operation will be but half done, and the sepsis will not be checked. The periosteum, if adherent, should now be peeled away from the bone with the aid of a periosteal elevator, and the bone itself should be thoroughly exposed by retractors held by the assistants. The cortex of the bone should now be chiselled away by outlining the part to be removed with the corner of the chisel, and then cutting out the piece with the gouge, so that it can be raised from the abscess cavity beneath

like the lid from a box. (Fig. 59.) If the operation has been a very timely one, the marrow may not contain actual pus, but it will be noted that there is less bleeding than when normal bone-marrow is exposed, and an abnormal amount of fat in liquid globules will



FIG. 59.—Acute osteomyelitis of the tibia. Removing the cortex.

be seen. This condition is not often encountered, however, because operation in these cases is more frequently done too late than too early. Usually a cavity containing pus will be met with, the abscess not having a wall of its own, but gradually merging into more healthy parts of the medulla. The softened and diseased portions of the marrow are now to be removed by scraping with a sharp spoon, and as much of the overhanging cortex as may be necessary for the attainment of good drainage chiselled away. The best cavity for the drainage of a bone affected by acute osteomyelitis, is one which may be described as boat-shaped. If the disease is very near a joint, and during the operation the healthy

synovial cavity is accidentally violated, the opening should be wiped immediately with a sponge wet in bichloride solution, one to one thousand, and then shut off from the septic cavity by a carefully placed gauze packing. During the progress of the chiseling an assistant should, with forceps, pick out all loose splinters of bone, and when the operation is finished the cavity should be well flushed out with an antiseptic solution, not only for purposes of disinfection, but also to get rid of the débris. In order to



FIG. 60.— Medullary canal open. Note boat-shaped cavity.

ascertain whether any vessels have been injured which might require ligation, the limb may be "milked" toward the wound, when the mouth of each vessel will be disclosed by the appearance of a little spot of dark blood.

The cavity in the bone may now be packed, and the greater part of the wound in the soft parts should be similarly treated,

though a few sutures at the ends, where the incision is much longer than the cavity in the bone, may be permitted. If phlegmon existed, counter-incisions must be made, and the soft parts drained with the aid of gauze or tubes.

The first dressing should be dry. The entire limb, with the exception of the fingers or toes, should be enveloped in thick rolls of gauze or cotton and bandaged from below upward, very firmly and neatly, so that pressure shall be even and strong, and the influx of blood to the part, when the elastic constrictor shall have been removed, to some extent controlled. Otherwise the hemorrhage may wash out or loosen the packings. When the dressing is completed, the limb should be well elevated and the constricting band removed. After a few seconds, or at most within two or three minutes, there should be such a return of blood to the part that the fingers or toes exhibit a marked hyperæmic blush, which in the course of half an hour or an hour will gradually subside. The limb should remain for several hours in its elevated position.

The nurse or attendant should be ordered to watch the dressing in the region of the wound for the appearance of hemorrhage or other discharge, and when possible the patient should be so arranged in bed that the part which was operated upon shall remain in sight. It is also necessary to observe that portion of the dressing which is lowermost, as the patient lies in bed, with the part elevated, for blood will often run down underneath the dressings, appearing not through the portion covering the wound, but at the edge of the bandage. If a little blood or bloody serum shows through the dressings, a piece of dry gauze should be pinned or bandaged over the spot, but unless the discharge is very profuse, it will not be necessary to redress the wound for from twenty-four to forty-eight hours, when a wet dressing should be applied. The best reason for a change of dressing in cases of this kind is the continuance of the septic symptoms, or, perhaps, even an exacerbation. Occasionally, in spite of the most painstaking and conscientious work, the sepsis remains unchecked. If now the disease

seems to depend upon the presence of a single focus of infection, and the symptoms threaten life, the entire affected part should be ablated as a life-saving measure. And indeed, even if it seems that with long-continued treatment the part might be saved, it is not the part of wisdom to make the attempt in the interests of conservative surgery, if there are not good grounds to suppose that the patient will survive the experiment. The question may be a most difficult one, and in its solution the wisest and most experienced may err.

After the first change, the wound should be dressed as often as may be necessary to keep the parts clean and clear of the irritating discharge. If the bare bone becomes covered with granulations so that the probe no longer detects it, healing will probably progress uninterruptedly, but if the bone will not cover, it is probable that more or less of it will necrose, and another operation may be required for its removal. When the entire wound is granulating, and the discharge has very much diminished or has become stringy or serous, dry or oily dressings should be employed to hasten cicatrization.

Acute osteomyelitis treated in the way which has just been outlined will not only give the patient the best chance of recovery from the life-threatening sepsis, but, if the operation is performed early, it will often prevent permanent crippling from necrosis of bone.

Acute Suppurative Arthritis. — Suppurative inflammation of the joints may be due to infection from within, brought to the region by the blood current, or it may be caused by direct extension from adjacent inflamed tissues, or by direct infection from without, through injuries actually invading the joint-cavity. In any case, the condition of acute intra-capsular suppuration is shown by the presence of great tension with deforming tumefaction, and, later, redness of the surface. There is severe pain and great tenderness on the slightest manipulation of the articulation, which is held at an angle varying with the joint involved, the position being that at which

there is the greatest joint capacity, so that the sensitive and distended synovial sac may be stretched as little as possible. There is always considerable sepsis with acute inflammations of this kind, varying with the virulence of the microbes, the resistance of the individual, and the magnitude of the joint.

Diagnosis. — Early recognition of the affection is not always easy, because of its resemblance to acute articular rheumatism. The severity of the symptoms, referred, usually, to a single joint, the failure of antirheumatic remedies, the high degree of the sepsis, and, when it can be obtained, the history of an infecting injury, will be aids in determining the character of the trouble. It may, however, be impossible from the signs and symptoms alone to determine whether we are dealing with a rheumatism or an acute suppuration. The aspirating needle should in these cases be employed to settle the question. It is needless to say that the aspiration should be performed with the strictest attention to asepsis, for it is quite possible to carry suppurative infection into a joint affected by some other form of inflammation. Just as much care should, therefore, be observed in performing an aspiration as when the gravest surgical operation is to be undertaken. The disinfection should be thorough, and, as an additional precaution, a minute incision should be made with a scalpel through the skin where the distended joint seems nearest the surface, and a good-sized aspirating needle should be passed through this incision, so that germs from the sub-epidermal layers of the skin shall surely not gain entrance. Having thus ascertained the presence of pus in the joint, the proper treatment will be drainage of the articular cavity.

Drainage of Suppurating Joints. — After the pus has been found by the aspirator, one attempt is justifiable to wash and disinfect the joint without actual incision, this procedure being more likely to succeed in children than in adults. Accordingly, the needle which was used in aspirating may be left in place, and another and larger needle, or even a small trocar and cannula, introduced into the joint at another point, preferably opposite the original one. With a

sterile hand syringe or irrigator, normal saline solution should be injected through the first needle, so that after distending the articulation it shall escape by the counter-opening, and when the fluid comes out clear, a half-ounce of five per cent. carbolic solution may be injected and by gentle massage carried to all parts of the joint, when the saline solution should be again employed in order to wash out the carbolic, which, especially in children, may be absorbed and give rise to toxic symptoms. If the patient is a very nervous or sensitive individual, general anæsthesia may be required for this procedure, but in some instances, especially where the joint involved is not a large one, no anæsthetic is necessary.

When the little operation is completed, the entire limb should be thickly enveloped with a sterile absorbent and elastic dressing, the region of the joint and the parts distal to it being especially well compressed, and the entire limb immobilized with the aid of wooden splints or plaster of Paris. If the symptoms subside after the joint irrigation, the dressing may be left in place for several days, when it may be changed for a lighter one, keeping up the fixation for at least a week longer, when gentle passive motion may be commenced. If, however, there seems to be no improvement, or if the amelioration is but transitory, more radical methods of drainage must be employed.

For the operation of incision and drainage of a joint, the patient must be fully anæsthetized. One assistant besides the anæsthetist should be at hand. The instruments required are a scalpel, two to four artery-forceps, a pair of scissors, a pair of dressing-forceps, a large-buttoned probe, a pair of small sharp retractors, drainage tubes, and an irrigator or hand syringe. Ligatures, sponges, and dressings must not be forgotten. The location of the openings must, of course, depend on the joint implicated.

Shoulder. — In the shoulder the first incision should begin at the anterior part of the acromion, proceeding downward and parallel with the fibres of the deltoid. The dissection should be a careful one, and, with the aid of retractors, as much as possible

should be done under the guidance of the eye. A blunt dressing-forceps should be forced, by way of the articular opening, through the capsule at the back of the joint to the skin, where a counter-incision made on the instrument as a guide will allow it to be extruded. A drainage-tube placed between the open jaws of the forceps may now be seized and drawn through the joint, where it must remain until the diminished discharge will permit its removal. The cavity should now be well flushed out through this tube, a wet dressing applied, and the joint fixed by a firm bandage. Daily inspection and palpation of the region is necessary after the drainage of any joint until healing is fully established, in order that no pocketing of pus may take place.

Elbow. — This joint requires no additional directions as to treatment, except that it may be reached by incisions at either side of the olecranon. The dissection at the inner side must be particularly careful, in order that injury to the ulnar nerve may be avoided.

Wrist. — The only additional suggestion necessary in discussing drainage of this articulation is that incisions should be made where the joint distention appears most prominently, but that the flexor aspect is to be avoided if possible. The joint should be fixed in a position of partial extension, the fingers being at first included in the splint. The splint should be so padded that the palm shall be supported, and the fingers allowed to assume partial flexion.

The Hip. — Acute suppuration of this joint is, fortunately, far from common. A single incision is usually sufficient to drain it. The instruments and assistants will be the same as those enumerated above, but the retractors must be large and there should be at least half a dozen artery-forceps. After the patient has been anæsthetized, he should be laid upon the sound side, the flexed knee of the diseased side resting on a hard pad or pillow. The incision should begin at a point midway between the anterior superior spine of the ilium and the greater trochanter, and should extend toward the posterior portion of that landmark. On reaching this point, the incision may turn forward into the axis of the thigh,

extending so far as to bring the trochanter at the middle of the wound. The dissection should be a careful one, and all bleeding checked as the operation proceeds. The capsule having been opened, the joint should be thoroughly washed out with a stream from the irrigator, and drainage-tubes inserted. No sutures should be put in, the entire wound being packed with gauze and dressed dry. A firm spica bandage of the hip completes the dressing. The patient should now be put to bed and an extension



FIG. 61.

applied. This may be done in the following manner: having cut pieces of adhesive plaster, preferably of the kind known as "moleskin," into strips or bands two and a half to three inches wide, and long enough to reach from the hip to five or six inches beyond the sole, they should be slit as shown in Fig. 61 and neatly applied to the limb with the aid of a flannel roller bandage in such a manner as to avoid, as far as possible, all folds or creases which might irritate the skin. The foot should be bandaged in such a way that the plaster strips shall not touch the

patient's skin at the ankle, the flannel bandage preventing. (Figs. 61 and 62.) A stout cylindrical stick about half an inch in diameter and notched so that it will not slip out of position, should now be slipped through the openings made in the folded ends of the plaster which project beyond the sole. To the middle of this stick



FIG. 62.—The weight is supplied by a bottle of shot.

through a pulley fastened to the foot of the bed, and is tied to a weight which swings clear of the floor. This weight may consist of a shot bag or two or more smoothing-irons, so that it shall weigh between seven and twelve

pounds, according to the weight and strength of the individual. (Fig. 62.) The foot of the bed should be elevated about two inches, so that there will be less tendency on the part of the patient to slide downward. When the dressings are changed, the weight should always be lifted gently. If the muscles are suddenly released, there may be spasm and pain. The extension must be kept up until the patient is well, and even then it may be necessary for a time that he should wear an extension splint.

The Knee.— This is a large and complicated articulation, and in order that it may be thoroughly drained, from four to six incisions may be required. The operation is, however, a simple one. The first incision should be made where the joint appears nearest to the surface on either side of the patella, and then, with the aid of a dressing-forceps or a blunt probe, other incisions for counter-drainage may be made at each side of the posterior part of the joint, taking care that the external popliteal nerve shall escape injury. Two other incisions may be made if it seems advisable, above the

first two and opening into the quadriceps bursa. The knee cannot be drained through the popliteal space. Red-rubber drainage-tubes should be employed when it is possible to procure them. After the operation, the entire limb must be fixed or there will be great pain. At first the position may be at a slight angle, which may be managed by bandaging the limb upon a double inclined plane. If the drainage has been successful, the knee may be gradually straightened, and a removable plaster of Paris splint may take the place of the inclined plane. If, after thorough drainage by this method, the septic condition of the patient seems still to be unchecked, one more attempt may be made to save the limb. This consists in the wide laying open of the joint by an incision in front, below the patella, cutting all the anterior structures of the articulation and the crucial ligaments, removing the patella, and opening the quadriceps bursa by a vertical incision. The whole joint is thus exposed and the wound packed, the limb being bandaged at a right angle. If after the operation it appears that the procedure is to be a success and the sepsis is overcome, granulation of the entire wound sets in, and then the limb may once more be straightened. A stiff knee is, of course, the result. When even this method has failed, the patient still remaining septic and losing ground, amputation through the thigh above the limits of local infection must be performed.

The Ankle. — Two incisions will suffice at first, but if the suppuration goes on in spite of these openings others must be made wherever increasing pain and tenderness demand it. The primary incisions should be parallel with the tendons at places where the joint seems most superficial, counter-openings being also made. During the after-treatment the foot must be kept at right angles to the leg by a removable plaster of Paris splint. (Page 162.)

CHAPTER VII

REGIONAL SURGERY. THE HEAD

Lacerations of the Scalp. — These wounds usually bleed very freely, both on account of the vascularity of the region, and the fact that since so little soft tissue overlies the bone, injuries inflicted by blunt force resemble incisions. The treatment is, first, hemostasis, then disinfection, and finally closure of the wound with or without drainage according to circumstances. In practising disinfection of this region, shaving should on no account be omitted; for the scalp is a locality where erysipelas is frequent, and where it is doubly dangerous on account of the liability of the extension of the infection to the cranial contents by way of the lymphatics and the veins.

As to the closure of scalp-wounds, it may be said that those which run parallel to the sagittal suture seldom or never require stitching even when they are very long, simple pressure by a dressing being sufficient to keep the lips of the wound together, while suture will be necessary when the injury is transverse, cutting across the fibres of the occipitofrontalis muscle, which, contracting, tend to separate the lips of the wound. Sutures judiciously placed will check much of the hemorrhage by embracing the bleeding vessels, so that only the larger ones will require ligation.

The healing power of the scalp is very great, so that even the severest lacerations amounting almost to actual scalping will do very well, if the parts are disinfected and held in their normal position. No portion of the scalp should ever be cut away until it has certainly necrosed.

Unless it is considered very improbable that the wound will escape infection, it is best not to drain scalp injuries at the first dressing, but to do everything possible to obliterate all dead spaces by a firmly and neatly bandaged elastic dressing. If, then, suppuration occurs, it will be limited to one portion of the scalp, instead of burrowing about between the soft tissues and the pericranium, in what is known as the dangerous region. In cases which are not seen until this has taken place, we sometimes encounter what is called floating scalp, where this entire space is filled with pus which raises the scalp from the skull. The septic phenomena are often slight until the infection is well advanced, with the production of marked local signs. A comparatively trivial wound, perhaps healed externally when the patient is first seen, may have been the cause of the trouble. The picture of the condition is a striking one, the forehead bulging, the eyelids swollen, and the entire scalp presenting to the touch the sensation of fluctuation to such a degree that it recalls a water-bed. The only treatment which will afford relief is multiple incision at the most dependent portions of the scalp, the openings being made in a vertical direction in the back and at the sides, and transverse at the brow to avoid obtrusive scarring. Drainage should be by tube, and irrigation should be practised only at the time of operation unless for some reason there is a great amount of retention at the change of dressings, when the incisions should be carefully examined to see whether they are sufficient. Wet dressings should be the only ones employed until the healing process has been pretty thoroughly established.

Fracture of the Skull. — This accident may be the result of direct or indirect force. An example of direct force would be a blow with a blunt instrument directly upon the cranium, while indirect force may be exemplified by a fall upon the buttocks, which transmits the shock along the spinal column, causing fracture at the base of the skull. Besides, there is a form of fracture where the force applied is at a point on the cranium opposite the break. This is known as *contre coup*.

Fractures of the skull, compound or simple, may be further described, according to their form, as fissured, stellate or star-shaped, depressed and comminuted. Penetrating and perforating wounds of the skull, such as gunshot wounds, form a special variety. Fractures of the cranium may affect the entire thickness of the bone or the outer table alone, while in some instances, where the force was very blunt, the phenomenon of fracture of the inner table without apparent implication of the outer has been observed. Injuries to the skull may involve the bone alone, or they may be complicated with laceration of the brain or its coverings. The symptoms of fracture of the cranium may be very late in making their appearance, and the lesion is therefore often unrecognized for hours or even days after its occurrence. It is best not to be too positive in the diagnosis of injuries to the head, and to be on the alert for manifestations of an ominous character, even when the case seems to be a simple one.

Signs and Symptoms of Fracture. — When in fracture of the vertex there is a wound in the skin, the diagnosis is comparatively easy, but great care must be taken, if the probe is used, not only to avoid infection by this often-abused instrument, but also to keep from inflicting mechanical injury upon the tissues beneath the skull. If no open wound exists, cautious palpation should be practised over the seat of injury, when sometimes depression may be detected. Very frequently, however, there is an area of pulpification of the scalp which feels very soft to the touch, and, being surrounded by sharply defined edges of the hard, healthy tissues, gives one the false impression that we are dealing with depressed bone. Where symptoms of compression exist, it is best to be on the safe side and to make an exploratory incision. If, however, no evil symptoms are present, immediate operation is not demanded even when palpation seems to indicate depression.

When palpation shows, unequivocally, the presence of fracture, great gentleness must be observed during the examination. The least violence may give rise to motion of the fragments, with possible injury to the soft parts beneath.

The occurrence of hemorrhage under the conjunctiva indicates fracture of the orbital plate of the frontal bone. Swelling of the vault of the pharynx should cause suspicion of fracture of the basilar portion of the occipital. Loss of the sense of smell means injury to the ethmoidal plate, while hemorrhage with the discharge of bloody and watery fluid from the ear indicates fracture of the base passing through the petrous portion of the temporal bone. The appearance of brain substance with or without cerebro-spinal fluid at any wound of the head means that fracture of the skull exists. Paralysis of a portion of the face, as shown by immobility of certain muscles or the puffing out of one cheek with respiration, means cerebral injury either actual or by compression, as does also the occurrence of loss of vision in the whole or a part of the field. Inequality of the pupils is also a sign of cerebral implication. It is worth while, however, when the latter sign is observed, to note whether the patient may be wearing an artificial eye.

Paralysis or convulsive movements in a muscle or a set of muscles may indicate intra-cranial injury.

Deep unconsciousness from which the patient cannot be aroused is usually a sign of compression, while unconsciousness from which it is possible to arouse the patient, partly or completely, generally signifies concussion, a diagnosis which is strengthened by the occurrence of vomiting.

Gunshot wounds may be recognized by the punched-out appearance of the wound of entrance, the presence of bits of black powder, or a burned areola if the injured person was close to the muzzle of the weapon, and by the presence of one or more wounds of exit, though these, of course, only exist where there was complete perforation of the skull. When the skull has been struck by a hard-cased missile from a modern rifle, it will sometimes be found fractured and even comminuted to a great extent, but, as in these cases death is instantaneous, the treatment will not concern us.

Treatment: Compound Fractures. — When a scalp-wound is over a fracture of the skull, operation is the proper treatment, whether

there are symptoms of intra-cranial injury or not. Frequently ominous symptoms do not arise for a number of hours after the injury, and operative exploration then shows internal hemorrhage, the disastrous effects of which might have been avoided by earlier intervention. The removal of loose pieces of bone, together with the accomplishment of drainage, will be strong factors in the prevention of suppuration.

Operation. — Unless the patient is in a state of profound unconsciousness, general anæsthesia, preferably by chloroform, will be necessary. There should be two or more assistants besides the anæsthetist, although, at a pinch, it is possible to get along with one. The instruments required are the following: a razor, a scalpel, a dozen artery-forceps or as near that number as possible, a pair of scissors, sharp retractors, a periosteal elevator, a probe, a stout sharp spoon, a small chisel, a small gouge, a mallet or hammer, a stout dressing-forceps, catgut ligatures, needles and needle-holder, sutures, etc. Rongeur-forceps may be found very useful in these operations, although it is possible to work without them. Plenty of very hot, sterilized saline solution should be at hand, so that it may be cooled when needed to 110° or 115° . After the instruments have been boiled in the soda solution (Chapter III.), they must be thoroughly rinsed so as to get rid of the strong alkali, and then placed in pans and covered with the salt solution, for no antiseptic whatever should come in contact with wounds where the brain is likely to be exposed.

The scalp for several inches around the wound should be thoroughly shaved and scrubbed, and, if it seems to be especially dirty, it may be further disinfected with ether or alcohol, and then washed with sublimate solution, one to one thousand, which must in its turn be rinsed off with the salt solution. The anæsthetist should disinfect, and the chloroform mask or ether cone should be clean and freshly covered.

Basins of saline solution as hot as the hand can bear should stand near, so that it may be used to check minor hemorrhage

from the brain, which, by the way, bears high degrees of heat very well.

The wound in the scalp should be thoroughly disinfected by scrubbing, and by scraping with the sharp spoon. An incision enlarging the wound in the scalp and continued in the supposed direction of the fracture should then be made, the knife passing down to the bone throughout its course. Artery-forceps should grasp the entire thickness of the scalp wherever the edges of the wound bleed, and should be left in position for the present. The fracture should now be carefully inspected, and followed up by incising the soft parts, until the limits of the injury are known. If there is comminution, the loose fragments should be picked out with care, so that the brain or dura may not be injured, and if this cannot be done, because of wedging or depression, an opening must be made in the neighboring healthy bone in order that we may possess an unyielding fulcrum from which to pry up the fragments. This opening can be made with the chisel or gouge, which are thoroughly safe in this region if properly used. The instrument should be well slanted, and the mallet blows should be light, so as to raise thin layers of bone. It will be possible to know to a nicety just when the inner table is reached, and when the dura is exposed. Indeed, in the hands of a novice much less likelihood exists that the brain will be injured with the chisel than with the trephine. Having exposed the dura through an opening beside the fracture, the elevator or a curved scissors may be cautiously inserted beneath the edge of depressed bone, and, using the edge of sound bone as a fulcrum, the depressed fragment may be pried up and removed so that the dura may be inspected. Careful search should be made for bits of comminuted bone lying between the skull and the dura, and all such should be removed. If there is bleeding from a meningeal vessel, a suture of catgut put in with a hemostatic needle will check it, and if the bleeding comes from beneath the bone, no time should be lost in chiselling away more, so that the site of the hemorrhage may be found without

delay. The rongeur, if at hand, will be found very useful in quickly biting away the bone for this purpose.

The extra-dural space sometimes contains the blood-clot which has caused all the pressure symptoms. If coagula of considerable size are found here, they should be removed and the dura inspected. The extra-dural injury may be the only one, the membrane itself being quite uninjured. If, however, there is no pulsation and the dura looks dark, as if coagula were beneath, it should be incised for exploration, the incision being later closed with fine catgut interrupted sutures. If clots are found, they must be cleared away with the greatest care and delicacy, the bleeding points, if any exist, being checked by fine hemostatic sutures. Having closed the dura, all rough bone should be smoothed with the sharp spoon, and the scalp sutured, leaving one or two openings for drainage by strips or wicks of gauze. When the artery-forceps are taken off the scalp, to which they have been attached since the beginning of the operation, only the large vessels will require ligation, since the sutures will check the hemorrhage from the others.

If there has been laceration of the brain, only the loose shreds should be removed. Bleeding from those encephalic vessels which spurt should be checked by carefully placed hemostatic sutures of fine catgut, while general oozing may be controlled by gentle irrigations of very hot water, as hot as the hand can bear it. The irrigation had best be done by squeezing out sponges saturated with the hot water, and held but an inch or two from the bleeding surface. Drainage may be by gauze, or sterilized gutta-percha tissue, or both. No antiseptic chemical should be used when working upon the brain.

Simple Fractures. — If there is no open wound in the scalp, while symptoms of compression with or without the physical signs of fracture exist, exploratory operation is indicated. The incision should be made over the suspected site of the fracture. If bone injury is discovered, the other steps are those just described, while if no fracture is visible, one should be guided by the severity of

the symptoms, and the rate of their progress, as to whether or not it is wise to open the skull in spite of the absence of external signs of fracture. Even if the exploratory opening of the cranium should not yield a positive observation, it may do good by relieving tension caused by an œdema-like condition, which often exists after severe head injuries.

Fracture of the Base of the Skull. — The treatment of this serious injury is expectant and symptomatic. The patient should be kept in perfect quiet, sedatives or stimulants being used according to necessity. Cold in the form of an ice bag should be applied, and when there is a discharge from the ear the auditory meatus should be kept as clean as possible, and, with this end in view, should be frequently wiped out with a pledget of cotton, or gauze, moistened with an antiseptic solution; but no plugging of the opening should be permitted, for fear of damming back the secretions and interfering with drainage. The obvious presence of fracture of the base of the skull should never prevent the careful examination of the entire cranium for complicating fractures or other injuries.

During the after-treatment, the greatest watchfulness should be observed in regard to the patient's nutrition and elimination. Paralyzed muscles should receive daily massage and passive motion, and the mental confusion and depression so often present should be regarded as of very great importance, and should be treated morally by cheerful and reassuring conversation. The wound should be dressed wet and with moderate pressure, which may be slightly increased if there is a tendency to protrusion of soft tissue through the wound. This protrusion may consist of brain substance or granulations, or a mixture of both. If well marked, it is called a *hernia cerebri*. It may be cut off with the actual cautery, but no attempt should ever be made to reduce it.

Gunshot Wounds of the Brain. — When there has been complete perforation of the skull, with a wound of exit larger than that of entrance, the bullet has probably gone through entire, leav-

ing no metallic fragments within the skull. The only treatment which may be of benefit will be the enlarging of the wound of entrance, with the clearing away of débris. The wound of exit should be interfered with only for the purpose of removing loose fragments, and cleansing the laceration of the soft parts. A thin strip of gauze or a folded piece of gutta-percha tissue laid just within the cranium at both wounds, and covered with a wet dressing, completes the treatment, unless there are progressive signs indicating hemorrhage or pressure from some other source.

A guarded prognosis, in any event, should be given immediately after a wound of the brain has been received; for there is often a remarkable absence of alarming symptoms, and a number of hours may pass before the supervention of coma, paralysis, or other signs of grave cerebral disturbance. If there is a wound of entrance but no corresponding one of exit, it may be presumed that the missile is lodged inside the cranium, and probably in the brain, and, since bullets in the brain are very apt to cause serious trouble sooner or later, the proper treatment is that which is directed toward the removal of the offending object.

Operation. — Unless the patient is unconscious, full anæsthesia will be needed. Instruments and assistants should be the same as those enumerated under the heading of operation for fracture of the cranium, and bullet-forceps should be at hand as well. The patient should be in such a position as will bring the wound uppermost. The head should be thoroughly shaved, and the wound of the soft parts enlarged by incision, so that the aperture in the bone may be inspected. This should be enlarged with the chisel and rongeur, the fragments of the inner table being removed, and the entire opening rendered as smooth as possible. If there is considerable hemorrhage, which seems to come from a meningeal vessel, the point of injury should be sought and ligated with the aid of a hemostatic suture, still further enlarging the opening in the skull if necessary. It must be remembered that any missile, which had sufficient penetrating power to pierce the bone, has

probably passed completely through the brain and has struck the opposite side of the cranium, perhaps even rebounding from this surface back into the brain, but probably not into its original track. With a large-buttoned light probe, the direction of the bullet's course should be ascertained, the instrument being pushed with the lightest possible hand as far as it will go without resistance, even if it follows the path of the projectile as far as the opposite wall. The exact point where the track of the bullet would emerge, if prolonged to the surface opposite the wound of entrance, may be ascertained by the following method. With the *straight* probe in the track pass a string around the skull, commencing and ending at the wound, and in the same plane in which the probe lies. This is to be determined by "sighting." Mark this circumference by scratching the scalp with the scalpel. Now encircle the skull once more with the string, but in another direction, "sighting" as before, so that the string shall again be in the same plane with the probe. Mark this circumference also. The point of intersection of the two circumferences will be the location sought, and the probe may be removed. With this point as a sort of centre or focus, an incision the shape of a horse-shoe should be made down to the pericranium, this should be stripped up with the elevator, and a sufficiently large opening made with the chisel to permit of the careful inspection of the dura. It may be at once noted that this membrane has been lacerated or contused, or it may seem to be uninjured, while a dark area beneath shows encephalic traumatism. The dura should now be incised and the probe carefully inserted at this point to discover the second track of the projectile. If hard resistance is encountered, and there is doubt as to whether we have reached the bullet or a portion of the skull, the improvised electrical probe may be inserted to make sure, and the missile may then be extracted with the forceps. (Page 34.) A sterilized red-rubber catheter of suitable size should then be fenestrated, and slipped down to the place where the bullet was lodged; for the brain tissue rapidly comes together,

obliterating any artificial channels, and allowing the accumulation of fluids, septic or not, within the depths. After healing has commenced, this drain may be shortened from day to day, about a quarter of an inch at a time, so that the wound shall close from the bottom without the possibility of retention. The perforating wound of the head should be drained by a wick of parallel strands of silk drawn completely through the brain, by fastening them to the extruded end of the probe, and this drain should be made thinner and thinner by the daily removal of one strand at a time until no more remain. During convalescence, great attention must be paid to the patient's general condition, nutrition and elimination being especially watched, while paralyzed muscles must receive daily treatment by massage and passive motion.

The wound should be dressed wet, and with moderate pressure which may be slightly increased if there are signs of protrusion threatening hernia cerebri.

The treatment of wounds of the brain caused by the explosive action of modern arms need not be considered, because such injuries almost invariably produce instant death.

Suppurative Inflammation of the Salivary Glands. — The parotid and submaxillary are the ones most frequently affected. The infection usually extends from the mouth, and it is sometimes, as it were, invited by the irritation incident to the presence of salivary calculi. The specific epidemic inflammation called mumps is not uncommon, and while suppuration is not of frequent occurrence in these cases, it is occasionally encountered. Sometimes the infecting agent is carried to the gland by the blood stream in cases of general septic implication.

The disease manifests itself by swelling, pain, and tenderness in the affected region, accompanied by fever with or without chill, loss of appetite, and considerable prostration. Motion of the jaws is painful, and when the inflammation is in the parotid, the pain often shoots into the ear. Gradually these symptoms increase in severity, the tissues in the infected region becoming more and

more infiltrated and brawny, with a dusky or reddish hue of the surface. The constitutional symptoms become more threatening with the advance of the sepsis.

Treatment. — As soon as the diagnosis of suppuration can be made, the proper course to pursue is incision and drainage. The operation is a very painful one, so unless the case has been so neglected that the pus lies just beneath the skin, general anæsthesia should be employed. The instruments required are a scalpel, a pair of scissors, two to four artery-forceps, a pair of small, sharp retractors, a dressing-forceps, a probe, and a small sharp spoon. Ligatures, sponges, and dressings should be ready. The disinfection should be proceeded with on general principles (see Chapter III.), and the patient's ear should be plugged with gauze, so that neither disinfecting fluid nor pus may enter the meatus. If the disease is in the parotid gland, the incision *through the skin* should be vertical, and, while its edges are held apart by retractors, other incisions, transverse this time, should be made into the gland, so that the fibres of the facial nerve, which ramify throughout the parotid from behind forward, may be injured as little as possible. It will be found that the suppuration does not usually consist of one abscess cavity, but of numerous collections of pus separated by rather tough fascial walls. Each little abscess should be carefully opened, quickly curetted, and plugged with gauze, the entire wound being then left open, packed and dressed wet, unless there is considerable oozing, when the primary dressing may be a dry one, to be replaced by a moist one within a few hours. When, during the progress of the case after operation, other little abscesses or points of retention appear, they should at once be opened and packed.

If we are dealing with an abscess of the submaxillary gland, the anæsthesia will be found to be a very important part of the operation. Often there is trouble in opening the mouth of the patient, even with the gag, while the accumulation of mucus and saliva in the mouth and throat, together with the tendency to cyanosis, make the anæsthetist's task one of great responsibility.

The incision should be in a wide arc, with the lower line of the maxilla as the chord; or, if the swelling is not very extensive, a simple straight incision at right angles to the jaw will suffice. The wound should be held open with retractors, and the dissection carried carefully down through the infiltrated tissues into the gland itself, which will be found at a surprising depth. Often there are but a few drops of pus, or mixed blood and pus, to account for the enormous swelling. When the region of the gland is reached, the parts should be well sponged, so that the field may be clear and the operation finished under guidance of the eye. Having entered the gland structure by a puncture of the scalpel, the dressing-forceps may be inserted with closed jaws, to be opened as the instrument is withdrawn, thus tearing a sufficient drainage opening in the capsule. However little pus is found, the gland itself is probably in great part necrosed, so the curette should be used to remove as much as possible, and the entire wound packed. Before sending the patient back to bed, it is well to explore the ducts of the gland through the mouth by palpation, in order to determine the possible presence of calculi.

Sometimes, through neglect, the suppurative process is allowed to progress so far that phlegmon develops, and blood-vessels of considerable size become eroded. We then have the sudden formation of a tense, brawny swelling occupying a considerable part of the neck, eventually encroaching upon the trachea, so that suffocation is imminent. Indeed, tracheotomy may be required as a preliminary life-saving step before the operation of draining the phlegmon can be performed. (See next chapter.)

The after-treatment of cases which have been operated upon for suppuration of the salivary glands follows general principles, and does not require special mention here.

Acute Osteomyelitis of the Inferior Maxilla. — General involvement of the body of the maxilla is somewhat rare, though suppurative and necrotic foci are common enough. The disease ordinarily has its inception at the infected root of a tooth, which causes,

primarily, an alveolar abscess, often with osteomyelitis of the alveolar process. This is accompanied by considerable swelling of the soft parts, with more or less tenderness of the submaxillary and cervical lymph-nodes. Fluctuation soon makes its appearance, and a generous incision within the mouth along the gum where the pus is most superficial will usually give relief. The necrotic piece of alveolus is commonly cast off spontaneously, and comes away without trouble. Sometimes, however, the disease extends deeper, invading the bone itself, and then there is great swelling and inability to open the mouth, with the other cardinal signs of acute osteomyelitis as described in Chapter VI.

Operation. — General anæsthesia will be needed. Besides the anæsthetist there should be one assistant, though this one need not be a medical man. The anæsthetist, too, may be obliged to lend a hand, and he should, therefore, disinfect before the operation. The list of instruments should contain a scalpel, a pair of scissors, a dressing-forceps, from four to six artery-forceps, two pair of sharp retractors, one small and one medium or large, a small gouge and chisel, a mallet, a periosteal elevator, and a sharp spoon. Besides, there should be, as usual, probes, needles, a needle-holder, sponges, dressings, etc.

The patient's head should lie on the sound side, and his shoulders should be supported upon a thin, firm cushion. (Fig. 64.) The incision should be made parallel with the body of the bone, and about half an inch away from it below the chin, so that the resulting scar may be out of sight. The skin should now be dissected away and held with retractors, so that the outer face of the maxilla shall be exposed, and, after peeling away the periosteum, this aspect of the bone should be entered with the chisel or gouge. If a tooth has been the apparent cause of the infection, the first opening should be in the neighborhood of its root or socket, the cavity being afterward enlarged to the confines of the inflammatory process. If it appears that the osteomyelitis is limited to one focus, as much as necessary of the wound should be left open and packed

for drainage, while if the disease seems to have affected a great portion of the medulla, the entire wound should be allowed to granulate. The subsequent treatment requires but few words. The dressings should be wet and changed daily until granulation has well advanced, when a dry or oily covering may be used. The resulting scar is at first very unsightly, even at best; but as atrophy takes place the deformity is mitigated, and can be still further improved by excision. Since the cicatrix following this operation may be ugly, it is advisable, especially when the patient is a woman, to explain the case to her pretty thoroughly, and to be sure that an osteomyelitis really exists before operating. Alveolar abscess frequently causes a great deal of swelling, and the constitutional symptoms are often severe. Unless the case is extremely urgent, it will be wise to see how much improvement may follow the evacuation of the abscess within the mouth, before proceeding to more radical measures. On the contrary, however, where the constitutional symptoms are grave, and the progress of the disease rapid, the operation should not be too long delayed, for fear of further involvement of bone as well as the danger of sepsis.

After the operation, it is important that the patient should keep his oral cavity as clean and sweet as possible, and to this end he should brush his teeth every two hours, and rinse his mouth with an alkaline aromatic solution every hour, and after each time that food is taken. A teaspoonful of the bicarbonate of soda in a glass of peppermint-water makes a satisfactory mouth-wash.

Carbuncle of the Lip.— This extremely painful affection is remarkable for the great constitutional disturbance which it often occasions, as well as for the fact that it is actually dangerous to life, on account of its liability to cause thrombosis of the facial vein, which may extend to the deep jugular. There is always a tremendous degree of inflammatory œdema, so that the lip becomes enormously distorted, while the rest of the face participates, and the corresponding eye is closed by the swelling. If the infection is in the upper lip, a brawny infiltration extends far up the cheek.

Operation. — General anæsthesia is required. One other assistant, medical or unskilled, should be present. The instruments are a long-bladed sharp scalpel, two artery-forceps, a pair of small sharp retractors, a probe, and a pair of scissors. Ignoring the pustular “head” of the carbuncle, a generous incision should be made along the line of junction of the skin and the vermilion border, splitting the lip into two flaps by carrying the incision *completely through* the indurated tissues. Now holding the flaps apart with the sharp retractors, several layers of gauze should be passed with the aid of the probe to the bottom of the incision, and then, covering the wound and the lip with a pad of dry gauze, the dressing should be very firmly bandaged into place. There will be smart hemorrhage during this operation, but it is not usually necessary to tie any arteries except perhaps the coronary. The packing and the bandage will in most instances prevent serious bleeding. The dry dressing should be changed in six hours for a wet one. The packing may, if all goes well, be left in place for forty-eight hours. There is usually little or no trouble with the after-treatment of these cases, the large wound healing quickly, and the resulting scar in the muco-cutaneous region being scarcely visible.

Cancrum Oris or Noma. — Poorly nourished children are the principal sufferers from this malady. It is a phagedenic ulceration, beginning as a dark, gangrenous-looking patch in the cheek or the corner of the mouth. The destruction of tissue is very rapid, and constitutional symptoms of sepsis severe. The treatment should be general, and local. The general treatment is directed toward the improvement of the nutrition, and the local to the destruction of the disease at its limits. This is best accomplished by thorough cauterization, without regard to subsequent deformity. The actual cautery in general anæsthesia will best accomplish the end. Plastic operations to minimize the deformity will often be subsequently necessary.

Peritonsillar Abscess. — Quinsy is the popular name for this distressing but rarely dangerous condition. It is a suppuration in the

cellular tissues about the tonsil, usually subsequent to an attack of follicular tonsillitis, and probably the result of a mixed infection. There is pain on swallowing, together with some difficulty in breathing, more particularly when the affection is bilateral. There is usually a chill, and always a certain degree of fever. There is hypersecretion of thick, tenacious mucus in the throat, and the voice, owing to the presence of the swelling and also to the immobility of the inflamed palate, has a peculiar characteristic quality. On examining the throat, a bulging is seen in the soft palate above and to the inner side of the tonsil. If the case is a well-developed one, the palpating finger will detect a rather elastic mass with a softer area at one point, where the abscess, if left to itself, will probably rupture. This soft area has what is called a "crater-like" feel.

Treatment. — Incision and the evacuation of the pus will give the patient almost instant relief. No anæsthesia is required, and, with an intelligent patient, no assistant. The instruments are a head-reflecting mirror, an aspirator with a long needle, a sharp-pointed scalpel, a narrow-jawed dressing-forceps, and a tongue depressor of some sort. The patient should sit opposite the operator, holding the tongue down with the spatula or depressor. The position should be such that light from a window or lamp falls upon the reflector. If the crater-like feel is very apparent, the aspirating syringe need not be used, but the operator will plunge the knife straight into the swelling, at a point midway between the upper part of the tonsil and the inner border of the swelling, holding the scalpel with its edge downward and inward. In by far the greater number of cases this will open the abscess, but the incision should be made ample enough to drain the cavity thoroughly, by cutting downward and inward toward the edge of the soft palate. If there is some doubt as to the exact location of the abscess, it is best to make an exploratory puncture with the aspirating needle, which should be detached from the syringe when the pus has been found, in order that it may serve as a guard to the knife.

For two or three days after the abscess has been opened, the



FIG. 63.—Patient arranged for operation with the head dependent. Excellent for work about the oral, pharyngeal, and nasal cavities.

wound should be probed with a blunt instrument, so that its edges shall not adhere and cause retention.

Wounds of the Tongue.— These are usually transverse, being caused by accidental biting. If the wound is so extensive that a flap is formed, it should be sutured with few silk stitches passed very deeply through the tongue. If the patient is an adult, no general narcosis will be necessary, a little cocaine solution of from four to ten per cent. in strength, painted upon the mucous membrane, being sufficient to deaden the pain. If the patient is a child, however, general anæsthesia is required. The instruments which should be ready are a needle-holder and full curved needles with stout silk, a gag (Fig. 29), a large mousetooth-forceps, and a pair of scissors. One assistant, exclusive of the anæsthetist, will be needed. The patient should be placed in position with the head dependent, and the gag inserted. (Fig. 63.) A stout silk ligature should then be passed through the tongue, far enough back to insure a good hold in the tissues, and while the member is held well forward by the assistant, the sutures should be passed, none being tied until all are in place. Black silk is to be preferred in this region, since it is easily seen and is therefore not difficult to remove.

After the operation, the patient should be kept quiet and no solid food should be given for four or five days, when the stitches may be removed if they seem to cause irritation. If they do not inconvenience the patient, they may be left for six days, when firm union will be found to have taken place. During the time of healing, the mouth should be very frequently rinsed with a mild antiseptic solution, such, for example, as the alkaline peppermint-water wash. (Page 128.)

Abscess of the Tongue.—This is a rare condition. Tuberculosis and actinomycosis should be thought of as possible etiological factors, as well as the more ordinary causes of suppuration. It is characterized by painful swelling, with pain on speaking or swallowing, and when the suppuration is in the back part of the organ, by some impediment to respiration.

Palpation reveals a hard, brawny intumescence, tender to the touch and limited to one lateral half of the tongue. If suppuration has progressed far enough, fluctuation or the crater-like feel may be detected. The patient holds his mouth open, and seems to be in much distress.

Treatment. — Local anæsthesia, by painting the tongue with a ten per cent. solution of cocaine, is sufficient in most cases. Having placed a gag between the teeth, the tongue should be held forward by means of a silk ligature transfixing it, and the abscess should then be incised with a sharp scalpel. There may be a large suppurating cavity, which should be packed with gauze. As a rule these abscesses heal with great rapidity, and leave little if any deformity.

CHAPTER VIII

THE NECK

Wounds of the Neck: Cut Throat. — Incised wounds of the front of the neck, often inflicted with suicidal intent, may be immediately fatal from hemorrhage or from asphyxia, due to the entrance of blood in large quantities into the trachea, or, rarely, from air embolism. In self-inflicted wounds the cutaneous incision is ragged even when made with a very sharp knife; there is section of muscles and blood-vessels but usually not the largest, and the trachea or subhyoid region is almost invariably entered. When the throat above the hyoid bone has been cut it must be remembered that the tongue has also probably been injured and may drop back upon the rima glottidis, causing suffocation.

Treatment. — The first and most important step is to arrest hemorrhage. This should be temporarily accomplished by direct pressure in the wound with the fingers, covering, as well as possible, the principal bleeding points until they can be secured with forceps or clamps. Hemostatic suture through the bleeding mass should not be forgotten in this emergency. When the large veins have been opened, pressure at the proximal end should not be omitted in the hope of preventing the entrance of air into the circulation. Attempts should be made to rid the trachea of clots, and if the patient is too near death to make respiratory efforts, artificial respiration should be performed while the tracheal wound is held open. Having checked the hemorrhage the wound should be carefully cleansed and sutured, at least in part. The muscles may be approximated with chromic catgut, the nerves with fine silk, and the skin with rather thicker silk. The trachea should not be sutured,

nor should the skin directly over it. If the œsophagus has been cut and the wound can be easily approached, it may be sutured with fine silk or chromic catgut, the sutures not entering the lumen of the canal. If this operation is very difficult, no harm will come from allowing the wound to granulate. In either case the skin must not be sutured. Slips of gauze should be left to drain from the most advantageous places, and a wet dressing applied. If the patient seems dangerously exsanguinated, intra-venous saline infusion should be performed. (See Chapter IV.)

After-Treatment.— When the wound has been inflicted with suicidal intent, the patient may again seek to injure himself. He should, therefore, not be left alone for a moment, and his head should be firmly held in the flexed position with the help of a rigid dressing of crinoline or even plaster of Paris, lest voluntary extension reopen the wound. The dangers to be borne in mind are recurrent and secondary hemorrhage, infection of the wound with consequent general septic poisoning, pneumonia from the aspiration of blood, and cardiac irregularity or paralysis from injury to the vagi. Hoarseness, when the tracheal wound is so far healed as to permit phonation, may mean that the recurrent laryngeal nerve has been cut or otherwise damaged.

Recurrent and secondary hemorrhage are to be treated on general surgical principles. The form of pneumonia resulting from the aspiration of blood will necessitate stimulation and the other therapeutic measures which a broncho-pneumonia demands. In regard to the other complications, no special instructions are required here.

Nutrition.— Fluid nourishment may be taken by mouth if the patient is able to swallow; if not, the stomach tube must be brought into use. When the wound in the œsophagus has been left open there will, naturally, be an escape of some of the nutrient fluid from the opening when the patient swallows. The part should be cleansed each time that this occurs; but when granulation has begun the danger of infection from this source is very slight.

Gunshot Wounds of the Neck.— The gravity of injuries of this class varies greatly with the size and velocity of the projectile and the course which it has taken. If the missile has completely perforated the neck, missing the trachea and œsophagus, and if hemorrhage is slight, the treatment should be directed merely toward the preservation of the aseptic condition of the wound. A simple dry dressing should be applied, and the patient carefully watched for the appearance of signs of infection. Should these remain absent, the injury will probably not be followed by any serious consequences. This aseptic healing is most apt to occur when the modern steel-clad projectile was the vulnerating body. Indeed, the patient will often have recovered sufficiently to attend to his duties in so short a time as five or six days from the time of injury. If suppuration should occur, the wound must be enlarged, and drainage, if necessary, secured by other incisions.

If there is a wound of entrance but not of exit, and no vital part has been invaded, the projectile need not be sought and removed as a first step of the treatment, especially if the foreign body is presumably small, for such bodies frequently become encysted and do no further damage, while the operation of removal may be fraught with great danger. If suppuration occurs, however, the bullet should be extracted if possible. The method of locating such bullets does not come within the province of this work.

If the projectile is a large one, or if it is thought to lie in a position where it is likely to do harm, the patient should be as nearly as possible placed in the same position in which he was when he was wounded, so as to straighten the track of the ball, which has probably been obliterated by the sliding past each other of the various tissue-planes with the change of the patient's attitude. The wound should now be carefully explored with a large-buttoned probe. The improvised electrical instrument described on page 34 may here be found of service.

If from the hemorrhage it is apparent that a large vessel has been torn, pressure should be brought to bear and maintained until

the patient can be anæsthetized and the bleeding point found by dissection and ligated. Unless the bleeding is actually furious, a packing of gauze laid within the wound and held there by a bandage may take the place of the finger, which is, of course, the first and most natural hemostatic pad; but on no account should even a whiff of ether or chloroform be given unless the bandage round the neck has been removed and replaced by digital compression.

If the larynx or trachea has been pierced by a bullet, symptoms of suffocation are apt to follow at once from the irritation of the wound itself as well as from the presence of blood in the air passages. Tracheotomy without delay is the patient's only salvation. (See page 140.)

Acute Suppurative Processes. — Abscess in this region is very often of glandular origin, the infection coming from some external wound with lymphangitis or from a diseased condition in the mouth or pharynx. The tonsils are very commonly the primary seat of the trouble. There is usually some swelling and tenderness about one or more of the lymph-nodes, which the patient is apt to treat by poulticing and with other household remedies. The infection may progress rather slowly for some time, often for several days, when there is a chill and a rise in temperature with induration of the tissues about the node, and the patient at once becomes very ill, exhibiting the symptoms of acute sepsis. If not relieved by the evacuation of the pus, the abscess will probably enlarge and, finally, may burst its confining wall and become a phlegmon. The destruction of tissue from these infections may be appalling, the great vessels being laid bare and their walls even perforated by the suppurative process. If the inflammation is of the rapid type, there may be so much induration and infiltration that the larynx and trachea are pressed upon, the patient becomes cyanotic, and death impends, not from sepsis but from the impediment to respiration due to laryngeal œdema. Tracheotomy must then be performed before anything else can be done. If the case is not quite so urgent, however, the effect of generous incisions through the indurated

parts may be tried, thus diminishing the tension and giving the air passages relief.

Operation. — If tracheotomy is urgently called for, general anæsthesia should be dispensed with, but if the case is not quite so acute, ether or chloroform may be very carefully administered, remembering that suffocative symptoms are apt to arise during anæsthetization when the tissues of the neck are tense. One assistant besides the anæsthetist should be at hand. The instruments which may be used are a scalpel, sharp and blunt retractors, six artery-forceps, a dressing-forceps, a probe, a pair of scissors, two mousetooth-forceps, and a sharp spoon. There must also be needles and a needle-holder, sponges and dressings. Besides, in any operation about the neck where there has been much swelling, the instruments for tracheotomy should always be ready. (Page 143.)

The patient should lie upon his back with the head turned toward the more healthy side, and in stout subjects, or those where the neck is very short, a pillow or flat cushion should be used to elevate the shoulders and put the cervical tissues slightly upon the stretch. (Fig. 64.)

If, now, we are dealing not with a phlegmon but with a localized abscess, the incision should be made at the point of greatest prominence, and in such direction that the resulting scar may disfigure as little as possible. With this end in view, the natural wrinkles or folds of the neck may advantageously be followed.

Vertical incisions in the median line are apt to be followed by greater deformity than transverse ones. Dissection in this region must be performed with caution, since there are many important structures which must be avoided, or, at any rate, not carelessly injured. It may be necessary to sever quite large arteries or veins, but this should be done under guidance of the eye according to the technic laid down in Chapter IV. Especially important is the rule to secure all vessels before they are cut. When the abscess wall has been reached, the wound having become funnel-shaped because each layer has been opened by an incision shorter than the

preceding one, a minute prick with the knife will cause the appearance of a bead of pus. Into this opening through the abscess wall the closed blades of a slender dressing-forceps should be passed, and then, spreading them, the instrument may be withdrawn, tearing the opening larger. During this procedure dangerous force should



FIG. 64.— Patient arranged for an operation upon the neck. The shoulders rest upon a cushion.

never be exerted in such a direction as may cause the rupture of important structures. The cavity of the abscess should be explored with the finger, and then packed with gauze or drained by a tube according to its conformation, counter-openings being made if drainage cannot obviously be secured through the single incision. If the exploring finger detects sloughing tissue within the cavity the sharp spoon may be used to remove as much of it as will

easily come away. If there is a tendency to hemorrhage, the dressing should be dry for the first few hours, a wet one being applied later but without the removal of the drainage-tube or packings.

Phlegmon must be drained by numerous incisions according to general rules which may be found in Chapter VI. The region should be carefully examined every day for signs of retention, which may demand more packings or even new incisions.

Retro-Pharyngeal Abscess. — Retro-pharyngeal suppuration is caused by osteomyelitis or necrosis of the upper cervical vertebræ or of the basilar process of the occipital bone. In children, however, the disease is also met with as an extension from infections about the pharynx, fauces, or tonsils. It causes a bulging of the pharyngeal wall, either in the median line or toward one side. Deglutition and inspiration may be interfered with, while the presence of the intumescence gives rise to a peculiar quality of the voice. In children, the cry is often throaty and high pitched. Constitutional symptoms are present in varying degree, depending upon the kind of infection and the length of its duration.

Operation. — Incision through the mouth, especially in the case of children, is fraught with the danger of septic bronchopneumonia from the aspiration of pus which may occur in spite of all precautions. It is, therefore, best to evacuate these abscesses from the neck. One assistant in addition to the anæsthetist will be needed, and a scalpel, two artery-forceps, a pair of small sharp retractors, an aspirating syringe with a long needle, a pair of scissors, a grooved director, and a thin-bladed dressing-forceps, will constitute the list of instruments, besides the indispensable trachea-tube. Sponges and dressings should be at hand as usual.

Chloroform is the anæsthetic of preference in these cases, because etherization is so apt to be accompanied by accumulations of mucus in the throat and air passages.

Swelling is often visible from without, due partly to the abscess itself and partly to the presence of enlarged lymph-nodes. The patient should be placed with the head toward the unaffected

or least affected side. (Fig. 64.) An incision about an inch in length should be made behind the upper portion of the sternomastoid muscle and parallel with its fibres. After dividing the fascia, the underlying tissues may be separated by blunt dissection, using the handle of the scalpel for the work. The finger should now palpate the interior of the wound, especially the anterior part, where pulsation will show the location of the carotid. The aspirator needle should be passed inward and slightly forward with the finger as a guide until the suction of the syringe shows pus. The barrel should then be detached, and the needle allowed to remain in position to serve as a guide for the narrow-bladed dressing-forceps, which, entering the abscess closed, should be withdrawn open. These abscesses should always be drained by tube, and the cavity should be irrigated immediately with some bland cleansing fluid such as the normal saline solution, in order to make sure from the return flow that the tube is really within the cavity.

After the operation, the discomfort on swallowing and embarrassment of respiration almost immediately disappear. If they return, there is probably retention of the discharge due to plugging or partial slipping out of the tube, which should be at once taken out, cleansed, and reinserted. Sepsis which is unrelieved by the evacuation of the abscess should cause suspicion of the presence of other foci of infection, which must be diligently sought and treated according to their nature. (See Chapter V.)

Tracheotomy.—The circumstances under which it is usually performed make tracheotomy trying enough. The changed anatomical relations from œdema or infiltration of the tissues, the cyanosis, the dyspnœa, the faltering pulse, and all the dread signs of dire emergency, together with the feeling that the sufferer's friends look to us and to us alone to relieve the agony and save the life of their loved one, render tracheotomy one of the supreme tests of the surgeon's nerve, tact, and skill.

The opening of the larynx or trachea as an operation of emergency is indicated when an acute obstruction due to disease or to

the presence of a foreign body prevents air from entering the lungs. Retro-pharyngeal abscess, great œdema of the pharynx, the presence of diphtheritic membrane in the larynx, and œdema of the glottis, are some of the morbid conditions which may demand the operation.

Laryngotomy. — A foreign body in the larynx will cause the most violent symptoms of suffocation through spasm of the glottis, so that death is but a matter of a few moments if relief cannot be secured. After examining the throat with the finger in the mouth without any attempt at anæsthesia, a hasty vertical cut



FIG. 65. — Position for laryngotomy or tracheotomy. Note the elevation of the shoulders by the flat, firm cushion.

through the skin from the thyroid notch to the lower edge of the cricoid cartilage, followed by a plunge of the knife, point foremost, into the crico-thyroid membrane, will afford relief. The aperture in the membrane may be enlarged by a lateral slit if more space seems to be required, and, since the edges of the wound tend to come to-



FIG. 66. — A tracheal cannula or tracheotomy tube.

gether to such an extent that embarrassment of respiration may again occur, they should be held apart with retractors or, if these are not at hand, with two hair-pins bent so that the rounded tops, not the sharp prongs, may be used as blunt retractors until a tracheal cannula can be slipped into the wound. This instrument, shown in Fig. 66, is best made of metal.

It consists of an inner and an outer curved tube which can be easily taken apart, a flange attached to the outer end of the outer tube being provided with slits for the insertion of tapes which are to be

tied around the neck so that the instrument may remain in place. An oval opening at the convexity of the outer tube admits air to the trachea if the inner tube is removed, and the outer opening of the outer tube is plugged, provided, of course, that the pathological obstruction no longer exists. A few sutures through the skin above and below the tube may be put in so that healing may be expedited, and a pad of gauze slit to receive the tube should be placed between the instrument and the skin so that irritation from contact with the metal may be avoided. (Fig. 69.) A piece of sponge or loose gauze wet with warm water or saline solution should be tied over the tracheal cannula so that the air entering the lungs may be moist in imitation of the air which in normal conditions is rendered warm and moist by passing through the nasal cavities.

During the entire operation the patient, if he is conscious, must be soothed or bullied into subjection, while if unconsciousness has supervened, as is usually the case before the opening into the wind-pipe has been made, the operation must proceed with double expedition. As soon as the trachea, or in this case the larynx, has been opened, and before the cannula has been inserted, breathing may be suspended, or it may, on account of the relief which has been afforded, go on so quietly that it may seem to be absent. In either case artificial respiration should be practised until the patient makes efforts at coughing or until he is obviously restored to consciousness. If the operation was performed on account of the supposed presence of a foreign body, the finger should be passed upward and downward through the wound, and the throat should be once more explored from the mouth. If nothing is found, and it is supposed that the object has passed farther down, the patient should be placed upon a table elevated at the foot so as to be inclined at least thirty degrees, and efforts at coughing should be encouraged, while careful watch is kept at the wound so that the foreign body may be seized if it should make its appearance. If the object is not found, the patient should be put to bed and carefully watched. The presence of a foreign body in a bronchus

sometimes gives rise to attacks of dyspnœa, while bronchitis, or perhaps pneumonia, develops. Absence of respiratory murmur over a part of a lung is one of the signs of the impaction of a body in a bronchus or bronchiole.

If at the time of the laryngotomy a tracheal cannula is not at hand, the opening may be rendered temporarily patent by passing a stout silk suture through the skin and crico-thyroid membrane at each edge of the wound, and tying the sutures at the back of the patient's neck. This is, however, but a make-shift, and the tube should be procured and inserted as soon as possible.

When tracheotomy is performed for diseased conditions, there is usually time to prepare for the operation. General anæsthesia, preferably by chloroform, may be induced, one assistant and a nurse in addition to the anæsthetist being present. The instruments should be a sharp scalpel, a pair of medium-sized sharp retractors, a pair of small, sharp retractors, four artery-forceps, a dressing-forceps, two mousetooth-forceps, a

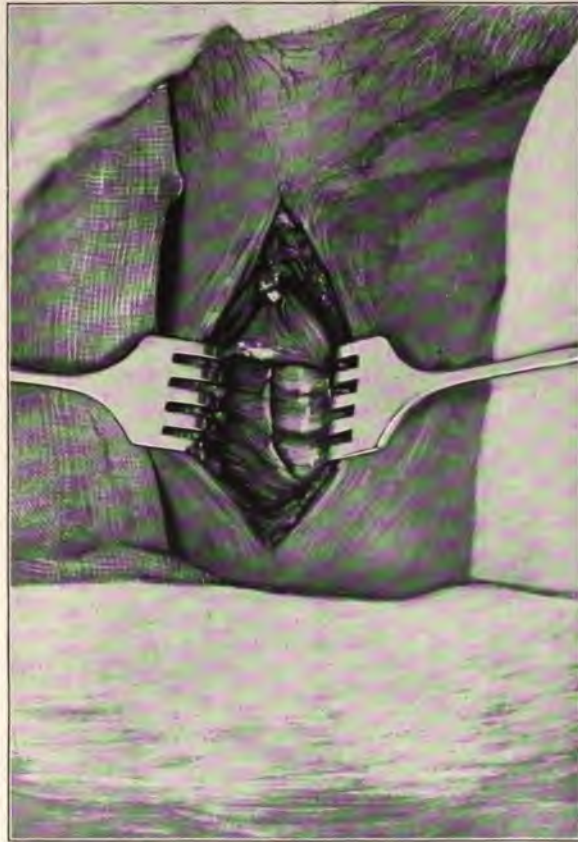


FIG. 67.—Tracheotomy in an adult. Thyroid isthmus. Three rings of the trachea are seen.

blunt hook or retractor, a pair of scissors, a stout rubber bulb with tubing attached, a needle-holder, needles, sutures, ligature, sponges, and the trachea-tube. The anæsthetized patient should lie in the dorsal position with the shoulders slightly raised, so that the tissues



FIG. 68.—Tracheotomy. The blunt retractor holds the thyroid isthmus out of the way. The handle of the scalpel inserted transversely keeps the tracheal wound patent.

at the front of the neck shall be put upon the stretch. (Fig. 65.) A vertical incision should be made from below the cricoid cartilage to the sternal notch, if the patient is stout or has a short neck. If the neck is slender, the incision may begin at a slightly lower point, but there must be room enough to see clearly what is being done. The wound being held apart by retractors, the dissection should proceed deliberately between

mousetooth-forceps until the isthmus of the thyroid body is exposed. This structure should be held up out of the way with blunt hook or retractor (Fig. 68), and the trachea carefully sought by palpation with the finger in the wound. During this digital exploration the patient must lie exactly on his back, so that the trachea may be surely on the median line, for it is not always an easy matter, especially when there is infiltration of the tissues at the front of the neck, to find the windpipe. Having felt the trachea and recognized it by its cartilaginous rings, it may be fully ex-

posed by blunt dissection with the handle of the scalpel and two or three rings incised to admit the cannula, which should not be inserted, however, until easy respiration has become established, the tracheal aperture being meanwhile rendered perfectly free by retracting its edges. The quickest way to hold open the tracheal wound temporarily, is by inserting the handle of the scalpel and turning it at right angles to the tracheal axis. (Fig. 68.) If breathing is still impeded the trachea above and below the opening should be gently wiped with a cotton swab firmly fixed to a probe in order that obstructing bits of mucus or pseudo-membrane may be removed. If this procedure does not succeed, the rubber bulb and tube may be used in the hope that through suction the obstructing substance may be loosened or extracted. The tube may be even inserted into the trachea as far as it will go. This apparatus makes suction by the mouth of the operator unnecessary, an act of heroism which, often enough, has saved the life of the patient at the cost of a far more valuable one, that of the self-sacrificing surgeon.

After-Treatment.—When the properly fitting tube is in position, phonation is, of course, impossible. The nurse should, therefore, be instructed to report immediately the fact that the patient has spoken, cried, or made vocal sound of any kind: for this would indicate that the tube is out of place. The room should be kept warm, 75° F. or even more being not too high a



FIG. 69.—Trachea-tube in position, with tapes inserted and slit compress of gauze to prevent unnecessary contact of the apparatus with the skin. A piece of gauze held in a dressing forceps is seen above. An assistant holds this so as to be ready to instantly wipe away clots, membrane, or mucus which may be coughed up.

temperature for the first few days after the operation, before the lungs have become accustomed to the changed quality of the air-supply. The moist sponge which covers the tube must be frequently changed, and the tube itself watched and cleansed with a feather without removing it, whenever there is rattling, coughing, or distress of any kind due to the presence of discharge. At least twice in twenty-four hours the inner tube should be removed, boiled in the soda solution, rinsed in plain water, and replaced.¹ Only when, in spite of all other efforts, the tube remains clogged so that there is danger that suffocation may ensue, is the nurse justified in removing the entire instrument, both inner and outer tubes, wiping out the trachea with the feather and retracting the edges of the wound while artificial respiration is being performed. A nurse would hardly be right to proceed to such lengths in the physician's absence, however, unless the patient were actually *in extremis*, and no medical adviser within call.

The wound should be inspected daily, and as convalescence progresses the outer opening of the outer tube may be tentatively plugged with the finger after the inner tube has been removed, in order to ascertain whether the obstruction for which the operation was originally performed still exists. If granulations form at the tracheal wound, causing obstruction, they may be removed by the curette, or they may be cauterized with nitrate of silver *fused upon a probe*. Under no circumstances should the solid stick of caustic be used, since the accidental breaking off of a piece of the "stick" may cause death through its falling into the trachea. In order to fuse the silver upon the probe it is but necessary to pulverize a small bit of the "stick," to heat the end of the silver probe red-hot, or nearly so, to apply the heated instrument to the powdered chemical, and to heat it once more in the alcohol flame.

When healing is well established, the tube may be removed, and the wound allowed to close by granulation without suture.

¹ Some trachea-tubes are made of aluminium, and others of hard rubber. These should never be boiled in the soda solution. Silver or German silver tubes may, however, be thus sterilized.

When tracheotomy or laryngotomy has been performed, for an exacerbation of some chronic stenosis of the larynx, the tube may have to be worn for a long time, perhaps even permanently. The lungs then seem to gradually accustom themselves to the changed conditions, so that after a time the wet sponge at the opening may be dispensed with.

Foreign Bodies lodged in the Œsophagus:— There is not, as a general thing, complete occlusion, and fluid nourishment can be taken. Inflammation with or without the formation of pus may, however, cause so much swelling that the obstruction becomes complete. There is usually time to secure the services of a specialist and urgent necessity for operation may not exist for a number of days. When, however, a hard and completely obstructing body has become impacted so that it cannot be dislodged with instruments passed from the mouth, there may be so much pain, together with the complete inability to swallow even liquid food, that operation for relief is imperative.

Œsophagotomy.— General anæsthesia, preferably by chloroform, should be employed, one skilled assistant being necessary at the wound in addition to a nurse or unskilled person as general aid. The instruments are a scalpel, a pair of large, sharp retractors, and a pair of medium-sized blunt ones, half a dozen artery-forceps, a slender dressing-forceps, a pair of scissors, two mousetooth-forceps, and a stout large-buttoned probe. A needle-holder, needles, sutures, ligatures, sponges, and dressings must also be ready.

The patient should lie so that his head, turned toward the right, shall bring the left side of the neck into prominence. A flat cushion should be under the shoulders. An incision four or five inches long should be made along the anterior border of the sterno-mastoid muscle, arranging, if possible, to have the middle point of the wound at the place of obstruction as ascertained by means of bougies, measured from the front teeth. The tender point indicated by the patient is also of some importance as a landmark. The dissection should proceed while the sterno-mastoid

muscle and the carotid artery and jugular vein are drawn backward with a blunt retractor, the other muscles being held out of the way toward the inner side. The thyroid body must be raised up. Having thus exposed the œsophagus, it should be palpated in order to discover the location of the foreign body, if possible, before the tube is incised. If nothing is learned by palpation, but the obstruction is known to be rather high up, the œsophagus should be opened accordingly; while if it is known to be low, the opening should be made as low as possible. The exploring finger in the opening in the gullet should now seek the impacted object, which, if found, must be removed with forceps. If no manipulation will dislodge the offending body, recourse must be had to gastrotomy or even gastrostomy.

The wound in the œsophagus need not be sutured, but may be left to granulate as described above in treating of accidental wounds of this region. (Page 134.)

Gastrotomy and Gastrostomy.¹—These operations may be urgently demanded when, through disease, injury, or the presence of a foreign body, there is occlusion of the œsophagus or its cardiac end, so that the food cannot enter the stomach by the natural channel.

Gastrotomy: Operation.—A description of the special preparations for abdominal section will be found in Chapter XI. Unless the patient is extremely nervous, local anæsthesia will be found sufficient. General narcosis by ether or chloroform is dangerous because the unconscious patient draws into his lungs mucus and œsophageal secretions which collect in great quantity and cannot be swallowed. The resulting broncho-pneumonia is often fatal some days after the operation.

Two skilled assistants should be present to help about the wound, while it is advisable to have some one stand at the patient's

¹ These operations, though properly coming under the heading of abdominal surgery, are placed here so that they may more directly follow the discussion of the conditions which they are most frequently intended to relieve.

head in order to talk to him, comfort him, and distract his attention from what is going on.

But few instruments are required for the work, a scalpel, medium-sized sharp and blunt retractors, a dozen artery-forceps, a long dressing-forceps, two mousetooth-forceps, a pair of scissors, needles, and a needle-holder, being the entire list. Ligatures, sutures, sponges, and dressings should be at hand as in all operations.

The incision through the skin should be four or five inches long, beginning at a point about an inch to the left of the xiphoid cartilage and running parallel to the costal border and about an inch below it. (Fig. 91.) All bleeding should be carefully checked, and the peritoneum incised. The stomach must now be sought and drawn out of the wound by its anterior portion. If, now, gastrotomy for the removal of a foreign body is to be performed, two stout silk sutures should be passed, with the aid of hemostatic needles, through the walls of the viscus to act as retractors, and gauze should be packed all about in such a fashion as to prevent the entrance of foreign matter of any kind into the abdominal cavity. The gastric wall should then be incised, the bleeding, which will be quite free, being controlled by clamps and artery-forceps. Then, the fingers being inserted, the foreign body should be found if possible and removed with forceps. The wound in the stomach may then be closed with silk sutures passing through all the coats except the mucous; and in order that the stitches may not be accidentally torn out it is necessary to put in from three to four rows or layers, thus approximating broad surfaces of gastric serosa which will form dense and firm adhesions. Having now closed the gastric wound, the surrounding serous membrane should be wiped carefully and the gauze packings removed. The wound of the abdominal parietes may then be sutured layer by layer, the peritoneum with catgut in running suture, the other deep layers with chromic catgut in interrupted suture, while the skin should be stitched with silk, a few extra stout button-sutures serving to relax the cutaneous margins so that they

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y be approximated more exactly with finer silk. If there is
doubt in the mind of the operator as to the condition of the line of
strict closure, a wick of gauze rolled in a piece of gutta-percha
sue so as to form a cylinder the thickness of a large cigarette may



70. — Gastrostomy. Peritoneum sewn to skin. The gauze packing keeps the viscera from prolapsing.

left as a drain down to the stomach through an unsutured part
the wound. If all goes well, this may be removed in from three
five days.

After this operation all precautions should be taken to prevent
the occurrence of vomiting, nourishment being given by the rectum

(see Chapter XI., page 204) for four or five days. Then, unless the patient is doing badly, liquid predigested food may be carefully given in small quantities by mouth. The bowels, of course, should be moved by enema.

Gastrostomy. — If it is intended to make a permanent opening in the wall of the stomach for the administration of food the opera-



FIG. 71. — Gastrostomy. Second step.

tion is called gastrostomy. The procedure is the same as has just been described up to the point where the peritoneum has been incised. This membrane should then be sutured to the skin by medium-sized silk sutures placed from a quarter to half an inch apart, special attention being paid to the union at the angles of the

wound. (Fig. 70.) A cone of anterior gastric wall should then be drawn out of the wound and its base sutured to the peritoneum by numerous fine silk stitches so that there may be no leakage whatever, the cone in the meantime being held tense by an assistant, who grasps the apex with a forceps. (Fig. 71.) Three

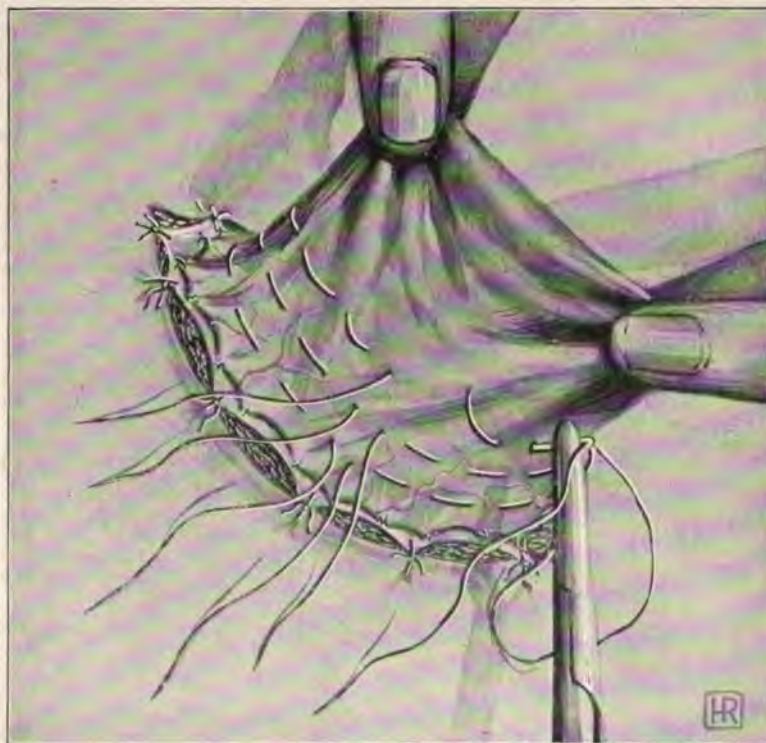


FIG. 72.—Gastrostomy. The purse-string sutures.

or four rows of purse-string sutures of silk should now be passed round the cone of stomach but should not be drawn tight, the loose ends being temporarily secured with artery forceps so that they may not become disarranged. The cone may then be inverted into the wound so that it will project as a conical elevation into the interior of the stomach. Its apex should

then be perforated and a rather stiff rubber tube, such, for example, as a red-rubber catheter, *not a woven one*, should be introduced through the aperture. While this is held in position the purse-string suture nearest the apex should be tightened, then the next one, and so on until all have been tightened. This will

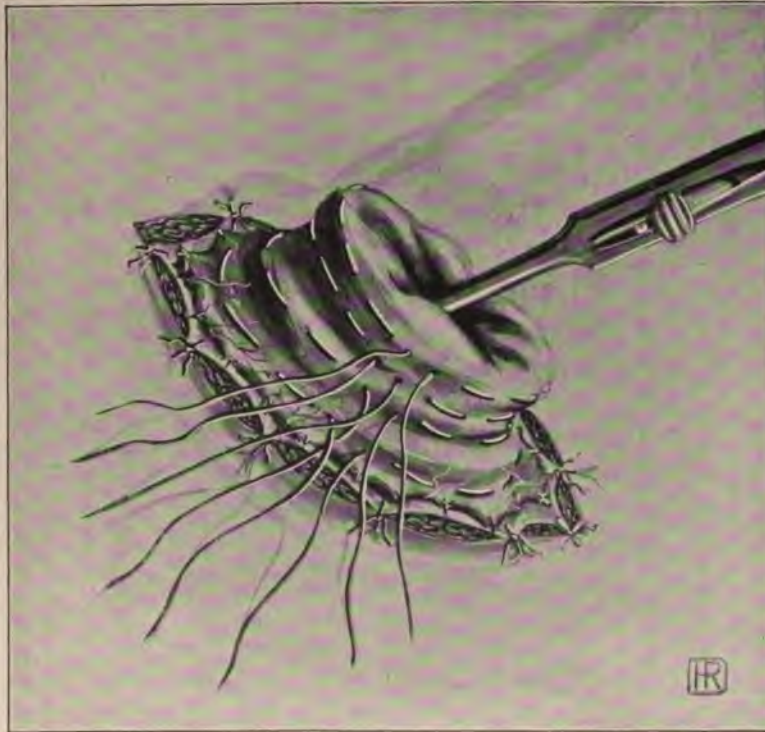


FIG. 73.—Gastrostomy. Showing how the cone of stomach is to be inverted.

effectually prevent the prolapse of the cone of gastric wall. The dressing is completed by a gentle packing of the wound with gauze and the securing of the tube with a safety pin.

If the patient is in a starving condition ordinary fluid nourishment may be at once poured into the stomach through the tube by means of a funnel or injected with a hand syringe. Until the

wound is nearly healed, it is best to keep the tube in the stomach, closing the outer end with a clamp or otherwise so as to prevent leakage. Then, however, it may be left out for increasingly long

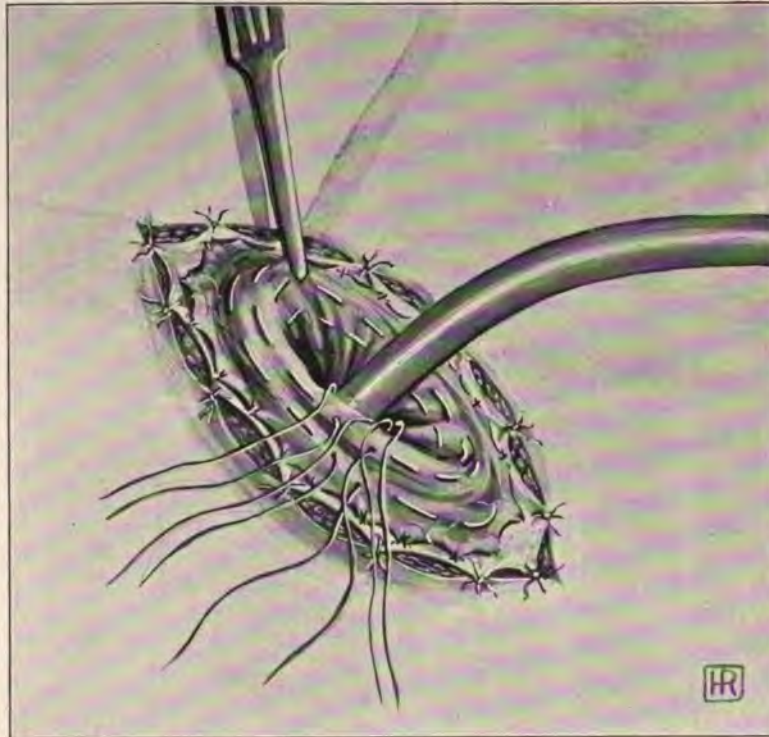


FIG. 74. — Gastrostomy. Cone inverted and tube in place. Nothing remains but to tighten and tie the sutures.

periods, until it is necessary to insert it only when food is to be taken. The cone within the stomach acts as a valve and pretty effectually prevents the regurgitation of food or of gastric secretion.

CHAPTER IX

THE EXTREMITIES

Severed Tendon and Nerve. — Wounds of the soft parts are to be treated according to the general principles described in Chapters II., III., IV.; but the treatment of severed tendon and nerve requires further description. The tendons of the hand and wrist, especially the flexors, are of the greatest importance, and their loss of function may mean great and permanent disability.

Diagnosis. — When a laceration or incision of the hand, lower forearm, or wrist has been received, the hemorrhage should be checked and the wound cleansed as well as circumstances will permit. Then the voluntary motions of the hand and of each finger should be most carefully tested. If there is great limitation or total absence of any of the normal motions of a part, nerve or tendon has probably been divided. The location and direction of the wound will be of assistance in determining the character of the damaged structure; but in general it may be called to mind that since the nerves of the arm which govern the motions of the hand as a whole and the flexion and extension of the fingers enter the muscles which they supply in the forearm at some distance above the wrist, a disabling wound in the carpal region must mean injury to tendon or to both nerve and tendon, while a wound higher up, especially if it is a rather smaller one, immediately followed by loss of motion, and perhaps sensation, in a considerable part of the hand, will make the diagnosis of nerve injury a safe one. Transverse wounds are more apt to do serious injury to these structures than longitudinal ones. A certain degree of motion may be pos-

sible even when all the tendons and nerves at the front of the wrist have been divided. This is due partly to the elasticity of the remaining tissues, which tend toward a certain natural position of the fingers, and also because when the tendons have been divided the proximal ends will for a time draw upon the distal ends through the tendon-sheaths, which may not have been completely severed. If tendons and not nerves have been divided, some digital motion is also possible by the contraction of the interossei and lumbricales.

Treatment. — When, on examination after hemostasis and cleansing, the diagnosis of division of tendon or nerve is obvious, the wound should be carefully and antiseptically dressed while preparations for the immediate union of the severed structures are made. If nerves have been cut, general anæsthesia will be required, though if the patient is a very phlegmatic individual the injection of a drop of four per cent. cocaine solution into the nerve-sheath, two inches above the proximal end, will suffice. Unless the patient is a sensitive individual or a child, local anæsthesia will be all that is

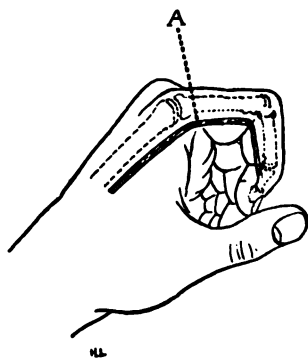


FIG. 75. — A marks line of section of a flexor tendon, the finger being flexed.

required for tendon suture, the anæsthetic solution being injected into the surrounding skin but not into the tendons or their sheaths, for these, when uninflamed, are not sensitive. At least one assistant at the wound is necessary.

The instruments for the operation are a scalpel, a pair of medium-sized sharp retractors, four artery-forceps, a small curved scissors, two stout mousetooth-forceps, a needle-holder, needles, ligatures, sutures, sponges, and dressing. The wound should be exposed with retractors, cleansed of coagula, and the disabled part placed in such a position as will cause the distal end of the tendon to protrude into the wound. This end retracts little, if any, but it is usually drawn away from

the wound by the motion of the part to which it is attached. (Figs. 75, 76.) The proximal ends do retract, being drawn up by their respective muscles. A little massage or milking, as well as the motion of the disabled member will usually suffice to bring the distal end of the tendon into view. When dealing with the fingers, it should be remembered that passive flexion of the metacarpo-phalangeal articulation relaxes the superficial or short flexors, while passive flexion of the phalangeal joints relaxes the deep flexor tendons which are *not* relaxed by the former manœuvre. Considerable and sometimes quite forcible "milking" may be necessary to bring the proximal portion into sight, and then it is apt to be covered with its theca or sheath, which hides the white and glistening structure of the tendon. It is very seldom necessary to incise or dissect in any direction in order to approximate the ends of recently divided tendons, though occasionally the wound must be somewhat enlarged in order that there may be room to work. The tendinous bands of the volar surface of the phalangeal articulations should never be purposely divided, for they cannot be reunited, and their absence renders the function of the finger imperfect and may even disable the member completely.

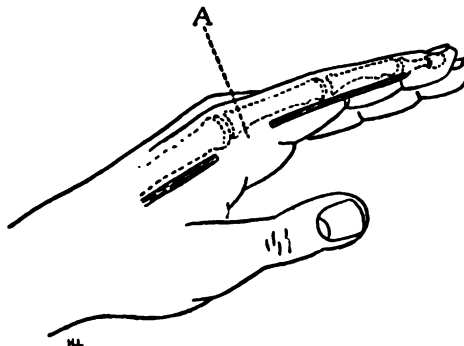


FIG. 76.—The distal end of the severed tendon is drawn away from the line *A* by the straightening of the fingers; the proximal portion is retracted by its muscle.

The ends of the tendons should be smoothed by trimming away shreds, and union should be secured by silk which should be sufficiently stout to insure its not breaking under slight strain. The method of putting in the sutures is illustrated in Fig. 77. Where many tendons have been cut, pains should be taken to seek out the ends which belong together, judging not only by ana-

tomical knowledge, but by the apparent relations which the ends hold toward each other. Anatomical plates may, however, be of assistance, and should be referred to if convenient.

When the severed ends have been restored, the skin wound be may closed by interrupted sutures of silk placed rather far

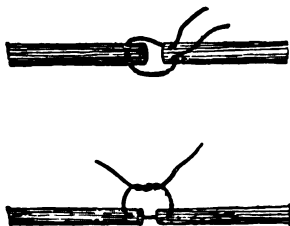


FIG. 77.

apart. No drainage-tube or gauze should be used in these cases, but the line of union should be covered with a strip of sterilized gutta-percha tissue, over which the dry dressing is to be applied. The position of the part during healing should be such as will allow of the greatest relaxation of the injured tendons, and this should be maintained by some form of immobilizing bandage material such as crinoline or even plaster of Paris.

After-Treatment.— So long as there are no signs of infection the dressing may remain in place for six days, when the skin sutures should be removed and a dry dressing applied. Immobilization should be as nearly perfect as possible for three weeks, when gentle massage should be practised twice daily and tentative voluntary movements may be commenced. In another week the patient may be encouraged to use the part freely, strong massage being continued if there is still some stiffness.

Suture of Nerve.— The ends of divided nerves should be sought and their continuity restored with fine silk sutures. In ten days, or as soon as the wound is healed, treatment by massage may begin. Indeed, gentle rubbing and kneading of the paralyzed muscles may be performed even earlier, so long as this does not interfere with the wound. Usually several months will elapse before there is complete restoration of function in a nerve which has been sutured, though not infrequently some signs of union may be observed in a few days following the operation.

Gunshot Wounds of the Extremities.— The subject of gunshot injuries in general has already been discussed in Chapter II., and

it is unnecessary that anything should be added here, except, perhaps, to emphasize the point that gunshot wounds of the bones may be regarded as compound fractures.

Lacerations of the Hand and Foot. — The treatment of lacerations of the hand should be conservative in the extreme. Beyond such incisions as may be actually required to insure drainage, little if anything should be done beyond careful disinfection and dressing. Above all, fingers should never be amputated unless infection has already caused necrosis of bones or tendons. Half an inch of finger-stump may be of the greatest value to the patient. It is astonishing how skilful individuals can become with such mutilated parts.

When the foot has been crushed or lacerated it should, to a certain extent, be treated the same as the similarly injured hand; but here the element of the usefulness of the part does not depend so entirely upon the conservation of every possible bit of tissue. If, therefore, much time and suffering can be saved by the amputation of toes or even of a part of the foot itself, the advisability of this procedure may be considered, provided enough of the foot is left to give the proper support to the body.

Phlegmon of the Hand. — Besides the usual principles of drainage by ample incisions a few additional directions concerning this form of suppuration, when it affects the hand or arm, will not be amiss. Acute suppuration of the pulp of the finger-tip may be the result of a tiny puncture, or it may begin as an osteomyelitis of the terminal phalanx. In the beginning it never invades the tendon-sheaths; though if untreated the process may eventually extend to them. The disease in this form has received the name of felon or panaritium. It is characterized by extreme throbbing pain which is usually worse at night, and by swelling and hardening of the finger-tip. If untreated, or wrongly treated by poulticing, the pus at last perforates, having destroyed more or less of the finger-pulp. The treatment is incision down to the pus cavity, but *not* necessarily down to the bone. Primary ether anæsthesia

or local anæsthesia with cocaine will be required, if the little operation is to be done neatly, and a rubber constrictor should be employed, so that blood may not obscure the wound. The incision should not be made, as is so often wrongly done, in the median line of the digit, but it should rather be along one side, so that the cicatrix may interfere as little as possible with the tactile sense. Having evacuated the pus, the cavity should be packed with orthoform gauze and covered with a wet dressing. If necrosis of the phalanx or a part of it develops, the bone should not be removed until it has loosened spontaneously.

When there is phlegmon of the finger above the first phalanx, the operation for the relief of the condition is the same as that already described, with the additional reason for deliberateness in making the incision that the tendons and their sheaths are, perhaps, still uninfected, and may escape if they are not violated by the knife. If in the finger the tendons or their sheaths are infected, a very guarded prognosis as to the restoration of function should be given, unless, indeed, the inflammation is confined to the extensors, when a good result is more easily attainable. Infection of the flexors of the thumb and little finger are likely to extend to the synovial sacs on the front of the wrist, while in the case of the remaining three fingers this is not so apt to occur.

Palmar Abscess is a phlegmon of the space beneath the palmar fascia. It should be opened freely, under general anæsthesia, by careful dissection, making one longitudinal incision through the fascia for the length of the entire palm, if necessary, avoiding the palmar arch which lies under it at the level of the lower side of the completely extended thumb. If it is evident that the incision must cross the line of this artery, the dissection should be a particularly careful one. An elastic constrictor is indispensable, so that hemorrhage shall not blur the field. (Fig. 78.) Occasionally more than one incision will be required, when drainage by tube should be established between the openings. It is very rarely necessary to incise the dorsum of the hand, though the œdema here is often

very great. It usually subsides when the abscess in front has been drained.

One of the commonest errors in the after-treatment of phlegmon of the hand and arm is the omission, until late, of passive and active motion. Just as soon as the suppurative process has begun to subside and granulation is progressing the patient should be instructed to move his fingers as constantly as he can with light, quick movements as if he were performing on the piano-forte; while every hour during the day he should, with the help of the other hand, make passive motions of the diseased one to the threshold of pain, but not beyond it. In this way convalescence may be shortened weeks or even months.

Osteomyelitis need not be further mentioned here than to refer the reader to Chapter VI., where the subject is discussed and the location of the incisions for operation upon the extremities will be found.

Compound Fracture of the Humerus. — (For general considerations on compound fractures see Chapter II.) After draining the wound by tube with or without counter-incision, the entire upper extremity from the top of the shoulder to the wrist should be immobilized by a light plaster of Paris bandage applied over the wet dressing of the wound and retaining the limb with the elbow at



FIG. 78. — Lines showing the locations for incisions in supuration of the hand. The dotted line marks the lower limit of the palmar arch. The incision for the relief of palmar abscess is *not* shown.

a right angle and the hand between supination and pronation. At first this thin splint should be cut off and reapplied as often as it is necessary to change the dressing, but later, when healing has begun, the plaster may be made thicker, fitting a little better over the diminished dressing, the same splint being used repeatedly. When this is to be done, the plaster should be cut through by two lateral incisions so that it can be easily removed and again held in place by an ordinary muslin roller bandage. Still later, when the discharge has become scanty, a heavy plaster splint with a window cut at the site of the wound will permit changes of dressings without the removal of the immobilizing splint.

Radius and Ulna. — The plaster of Paris splint should immobilize the limb with the elbow at a right angle, the stiff dressing extending well up the arm and over the metacarpal region so as to hold the hand in good adduction (toward the ulna). Motion of the fingers should be encouraged very early as in cases of convalescence from phlegmon.

Femur. — In compound fractures of this bone drainage is not always easy to secure on account of the thickness of the mass of muscle covering the break. Long incisions are often needed. If the injury is high up an extension apparatus may be applied, at least in the beginning; but when the fracture is in the lower two-thirds of the femur a stout fenestrated plaster of Paris bandage enveloping the foot, the leg, the thigh, and the pelvis in the form of a spica may be employed. When there is infection a short extension may be used, together with a light stiff splint such as the crinoline and veneering, and the dressings changed once or even twice a day. Recovery from the septic condition is here of greater importance than the immediate securing of perfect position.

The Leg. — After the first few dressings the fenestrated plaster splint will be found useful if the wounds are not too extensive. The thick splint cut into two lateral parts and bandaged on as described above when speaking of the humerus may be used in

some cases. No matter in what part of the leg the compound fracture exists, the immobilization should extend above the knee. When there is much pain from spasm of the muscles, this can usually be relieved by retaining the leg at a slight angle with the thigh, and having it lie upon a thick pillow or cushion. (Fig. 32.)

Compound Fracture of the Patella. — When this bone suffers compound fracture, the accident was probably due to great force directly applied, such, for example, as the kick of a horse or a gunshot wound. There is liable to be comminution as well, and often considerable injury to the joint. (See next subject.) The diagnosis is quite easy, especially when the open wound permits of exploration with the probe, a form of examination, by the way, which should only be undertaken after the most painstaking disinfection. If no other injury has been done and the patient is seen within a half-hour of the accident, he may be able to stand upon the damaged limb; but he will not be able to raise the heel from the bed with the leg extended as he lies on his back.

Treatment. — If there is much comminution with bruising of the soft parts, the patient should be anæsthetized, the detached fragments of bone removed, and the remaining portions made smooth with bone-forceps and the sharp spoon. The wound in the skin should be treated as a laceration according to the principles in Chapter II., a wet dressing being applied and the entire limb elevated upon an inclined plane. If the fracture is not a very complicated one and is probably aseptic, a good result may be obtained by suturing the larger fragments with silk, silk-worm gut, or silver wire, and removing the smaller ones. Holes should be drilled through the fragments in such a manner that the suture material shall not emerge upon the posterior surface of the bone. (See Fig. 79.) If there is much coagulated blood in the joint, it should be removed, and the articulation irrigated with saline solution, an ample transverse incision being made in order to gain access to all recesses. This incision may even take in as much as half the circumference of the limb. When the operation of suture of

the bone is completed, the skin may be closed with silk and short drainage-tubes of red or black rubber inserted just within the articular cavity. The entire limb should then be enveloped in an immobilizing bandage and placed upon an inclined plane. It will conduce to the preservation of asepsis if no finger enters the wound

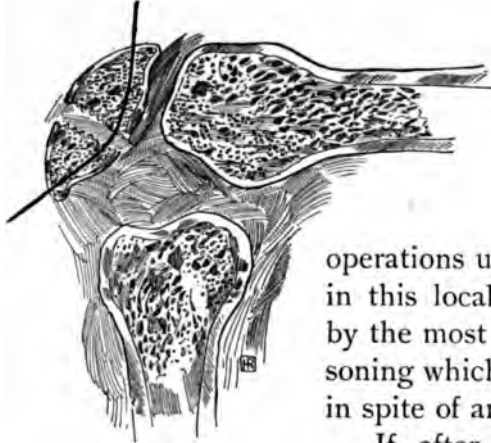


FIG. 79.

during the entire operative manipulations, only the well-sterilized instruments coming in contact with the tissues.

It is of the utmost importance to observe the very first untoward symptoms after operations upon the knee joint, for infection in this locality is very frequently followed by the most dangerous forms of septic poisoning which not uncommonly result fatally in spite of amputation through the thigh.

If after a compound fracture of the patella, symptoms of severe sepsis arise (Chapter V.), the joint should at once be drained by a sufficient number of incisions. (See page 112.) When the large transverse incision has already been made for the purpose of removing clots at the primary operation, this may be reopened and even extended, cutting through the crucial ligaments and draining according to the method given on page 113. If now, in spite of all that is done, the sepsis progresses, amputation of the thigh, making the bone section at the junction of the lower and middle thirds, must be performed. (Page 167.)

Wounds Involving Joints.— These should be treated with the hope of avoiding infection, and with a wholesome dread that it is, perhaps, already present. Punctures rarely require anything beyond the fixation of the joint and the application of cold. If they are known to have been made with a dirty instrument, they should be converted into incisions by cutting them across with the scalpel.

Incised wounds of joints should be well disinfected and then sutured, leaving a gauze tampon at the opening in the joint capsule, to be removed, if all is well, in three or four days. A wet dressing is the proper covering. Lacerations should be treated without suture, placing a tampon against the wound of the capsule and packing the skin-wound, which should then be dressed wet. If infection of the articular sac supervenes, incision and drainage is the treatment. (Chapter VI.)

Amputation.— This operation is necessary when absorption from a local infection, malignant or inflammatory, threatens the life of the patient, or when a part has been so far damaged through injury or disease that its conservation is obviously impossible.

The aim of the surgeon in performing an amputation, should be to save as much of the part as promises to be of use to the patient, while removing all that is necessary to place him beyond the danger which would arise from the presence of disease in the stump.

The conditions which might make the performance of this operation imperative are, first, local sepsis, threatening life in spite of all efforts to relieve the case by incision and drainage; second, irreparable injury to a part; and, last, gangrene or necrosis of a part from extremes of heat or cold or from mechanical interference with its circulation, as, for example, embolism of the arteries which supply it.

Amputation may be performed by section through the bone or by disarticulation. When the operation is done for the purpose of removing parts which have been injured by traumatism, section should be, as a rule to which there are few exceptions, through the bone; while if performed for osteal disease, it may be by disarticulation, unless, of course, the joint itself is septic, when amputation through healthy bone above is to be preferred.

The flaps should rather be too long than too short, and it will be found that those which consist of the skin together with its underlying tissues including the muscle are much less liable to gan-

grene than those composed solely of skin. The danger to life in amputations is directly proportionate to the size of the wound and its nearness to the trunk. Thus, the same operation will be more dangerous in a stout or muscular individual than in an emaciated one, and amputation of the leg will be less serious than a hip-joint exarticulation.

Amputations should not be undertaken during the period of shock which immediately follows an injury. The only procedures which may be countenanced at such a time are those which are undertaken to arrest hemorrhage and promote asepsis. It is better to apply elastic constriction for many hours, even at the risk of further destruction of tissue, than to operate during shock, when the death-rate is notoriously large. As a matter of fact the constrictor may remain in place for an astonishingly long time without actually causing necrosis; but it should, of course, be applied not far from the seat of the trauma, and the band should be wide enough to avoid exerting a crushing force upon the tissues.

Operation. — There should be at least three assistants besides the anæsthetist at a major amputation, fewer being required according to the size of the part to be ablated.

The necessary instruments are a stout scalpel (an amputating knife if one is to be had), stout, sharp retractors, a dozen artery-forceps, a dressing-forceps, strong mousetooth-forceps, a bone-cutting-forceps, a lion-forceps,¹ a periosteal elevator or raspatory, a pair of scissors, a needle-holder, and a saw. In an emergency a small carpenter's saw may be sterilized for the occasion, or the ordinary little scroll saw with the wire handle, which may be purchased for a few cents in most hardware shops, will be found very efficient, particularly when small bones are to be divided. A stout piece of close-meshed unbleached muslin and a piece of thick and strong sterilized rubber tubing, the latter to act as a constrictor, should be ready. Sutures, ligatures, sponges, and dressings must not be forgotten.

¹ The gas-pliers will act as a fair substitute for the lion-forceps.

As a typical operation the amputation of the thigh in the middle third will be here described.

The patient, having been anæsthetized, is drawn down so that the buttocks rest at the foot of the table. The healthy or uninjured lower extremity, well wrapped in a blanket, and covered with a sheet or towels, should be flexed over the back of a chair which is covered with aseptic material, the foot of the patient resting upon the seat. The part to be amputated, covered from the foot to a point well above the disease with aseptic dressings, should be held by an assistant, whose sole duty should be to take charge of the member until it has been ablated. This person should now elevate the limb to a vertical position, maintaining it thus for three or four minutes, in order to allow the



FIG. 80.—Method of compressing the femoral artery during amputation of the thigh.

blood to flow out of the veins into the patient's body. The constrictor should be applied evenly and firmly to the extreme upper part of the limb, with care that no fold of the skin shall be caught between the turns of the rubber. Thorough scrubbing and general disinfection, as described in Chapter III., should now be gone through with (see page 43), and the upper part of the thigh, including the constricted region, should be covered with antiseptic (or sterile) towels, the blanket-covered sound limb being similarly protected.

A trusted assistant should now place his hands beneath the aseptic coverings of the patient, and seeking the pulsating femoral



FIG. 81.—Skin and muscle incision. Note sterile dressing on part to be ablated.

artery with his thumbs, should stand ready to make compression in case of emergency. (Fig. 80.) With the amputating knife or the scalpel an incision through the skin completely encircling the limb should be made five or six inches below the proposed bone section. The skin now retracts to a considerable degree, exposing the fascia cover-

ing the first layer of muscle. This layer may now be in its turn divided with the knife and retracted, the remaining muscular coverings of the bone being divided similarly in two or three layers,



FIG. 82.—Amputation of the thigh. Note muslin retractor covering soft tissues above.

each cut higher than the preceding one, until the periosteum is reached. While the assistants make retraction, the periosteum should be incised and stripped upward with the elevator, exposing the bone itself. A large piece of the unbleached muslin, cut in the form of a slit compress, should now be used to cover and retract the soft parts while the operator is sawing the bone. (Fig. 82.) The limb should be held so that the saw shall not bind, yet at the same time so as not to cause fracture of the last part to be



FIG. 83.—The stump in a thigh amputation. The blood-vessels are caught with artery-forceps. The sciatic nerve is drawn out with forceps and is being shortened with scissors.

divided. The stump now forms a hollow cone, with the bone at its apex. The next step is to secure the vessels, and to divide the sciatic nerve at a higher point by drawing it out from between the muscles, and severing it with scissors. (Fig. 83.) The femoral artery and vein should be first drawn out of their sheath with forceps, isolated, and ligated separately and firmly with catgut. While the tissues are held apart with sharp retractors, the inter-muscular spaces should be examined for the mouths of other ves-

sels, which should also be clamped and ligated. When no more vessels can be found in this way, an assistant should make firm massage from the upper part of the limb toward the stump, when dark blood will escape from the unsecured vessels. When every bleeding point seems to have been secured, the stump should be elevated to a vertical position and sponges wrung out in water as hot as it can be borne by the hand lightly packed into the wound, while with other sponges pressure is made from without. The



FIG. 84. — The sutured and drained stump.

rubber constrictor may then be loosened, but not removed. If there seems to be no important hemorrhage, three or four minutes later the sponges may all be removed, and the stump inspected. Any little vessels which still need attention should now be caught, and the tissues of the stump brought together

from side to side, so as to make a vertical line of union. (Fig. 84.) If there seems to be considerable tension, a few stout silk button sutures should be passed through the skin and deeper tissues, while the skin itself should be neatly approximated with finer silk. A slip of gauze may be put in as a drain, and allowed to protrude from the upper angle of the wound, while a tube drains the stump cavity from the bottom. (Fig. 84.) The dressing, a dry one, should now be applied, the bandage covering the stump, which should be raised into a vertical position, and then passing round the body

like a spica. No great pressure should ever be made over the extremity of a recent amputation stump, for fear that the circulation in the flaps may be impeded. A very light wooden splint placed posteriorly, and long enough to protrude a little from the dressings, will act as a useful support.

After the operation the stump should be placed in such a position that it may remain easily accessible in case of recurrent hemorrhage, and the nurse should be instructed to watch the patient with care. It is a wise precaution to leave a rubber tube or ligature with the attendant for use in the event of dangerous bleeding. Shock, which is often considerable, should be treated by stimulation, and if necessary by saline infusion. Pain referred to the amputated limb may be so severe that morphine will be needed for its control.

If all goes well, the first dressing is left undisturbed for four or five days, when the upper drain may be removed, and the tube shortened. The sutures should be left in place for ten days, when they may be removed, substituting adhesive strips if there are signs of tension at the line of union. Local or general sepsis demands the immediate removal of the sutures, with open wound treatment and wet dressing.

Secondary Suture. — If the operation is done on account of infection, there is frequently some doubt as to the viability of the tissues at the level of the amputation. Where this doubt exists, it is best to put in a number of silk or silk-worm-gut sutures, taking in skin and muscle, but not to tie them for forty-eight hours, the wound being in the meantime packed with gauze. If at the expiration of this time there are no symptoms of sepsis, local or general, the packings may be removed and these sutures tied, thus closing the wound. This is one form of what is called secondary suture. It is especially applicable to cases of gangrene, or where the arteries are diseased.

Amputation of the Fingers. — It is seldom necessary to cut the bone in these operations, for amputation beyond the mere trimming off of loose or shreddy tissue should never be done, as a primary

operation following injury; while for disease, disarticulation is to be preferred. The volar tissues lend themselves most satisfactorily to the formation of a flap, which should, as a rule, be fashioned by incising according to the diagram. (Fig. 85.) In dealing with the



FIG. 85.—Lines of incision in amputation of fingers.

fingers, however, it should be our aim to save just as much tissue as we possibly can, so the formation of flaps will often depend upon the amount and character of the skin at our disposal.

Forearm.—Amputation of the forearm is best performed by the method of using an anterior and posterior flap. The muslin retractor should have three tails, the middle one passing between the radius and ulna. The saw should engage the larger bone first, and the smaller one should be first severed, before the saw has passed through the larger.

Arm.—The arm may be ablated by the circular method. When amputation at the shoulder-joint is to be done, the operation is commenced by making an incision parallel with the limb,

as it is held at right angles with the trunk, and passing between the insertion of the pectoralis major and the deltoid from a point below the junction of the middle and outer thirds of the clavicle for a sufficient distance down the arm. By dissection through this incision and severing the attachment of the pectoral muscle, the axillary vessels are easily exposed and ligated. The amputation may then be performed by making a circular cut at the desired level, dissecting out the head of the humerus, and securing the anastomosing vessels as they come into view, preferably before they are divided.

The Foot. — When on account of acute suppurative disease of the tarsus or metatarsus, it is deemed necessary to amputate as a life-saving measure, the section should be made through the leg and, in very critical cases, through the knee or thigh, instead of making an effort to save a portion of the foot itself; while if the operation has to be done on account of destruction of tissue by traumatism where there is no infection, amputation of a portion of the foot is justifiable and conservative. In the latter case no set method of procedure as to flaps and bone section should be followed, but as much tissue as possible spared, the only general rule of importance being to utilize the plantar skin wherever possible to cover the stump.

Amputation at the Ankle-joint. — The heel flap, if the integument of this region is intact and healthy, makes an excellent covering for the stump. The elastic constrictor should not be applied to the leg, but should encircle the thigh, which on account of its thicker muscular covering is less liable to contusion. The incision should begin at the outer malleolus, and having been carried straight round the plantar surface in a line with the leg, the foot being at right angles, should end a little below the inner malleolus just opposite the starting-point. The ends of this incision should now be connected across the instep. While the heel flap is drawn backward and held away from the calcaneum with sharp retractors, it should be dissected up until the tendo Achillis can

be reached and severed. The knife should then be made to enter the joint through the anterior incision, and the foot disarticulated.



FIG. 86.—Lines of incision for amputation at ankle, in the leg, and at the knee.

Having removed the malleoli by oblique section with the saw, so as to give the bony stump the shape of a rude truncated pyramid, the vessels should be secured, the skin sutured with silk, and the wound dressed. Drainage should be at the angles.

Amputation of the Leg above the ankle may be satisfactorily performed by making oval side flaps according to the incisions shown in Fig. 86. The three-tailed muslin retractor should be used when the bones are sawed, the saw engaging the tibia first, then dividing the fibula, and finally completing section of the tibia. When it is found necessary to sacrifice so much of the tibia that the bone section must be made only two or three inches from the upper articular end, amputation at the knee is to be preferred. If a very short stump of the leg is to be left, it is usual to excise completely the fragment of fibula, leaving the tibia as the only bone in the stump.

Knee.—The same shaped oval flaps may be employed in amputations at the knee-joint, taking care that the inner flap shall be sufficiently long to cover the internal condyle, which is longer



FIG. 87.—Incision for amputation at the ankle-joint with heel flap.

and larger than the external. The patella may be removed. (Fig. 86.)

Resection and Excision of Joints.— These operations are indicated as conservative measures when joints and the bones which enter into their formation have been so severely injured that the articular function has probably been destroyed. Resection is also performed in chronic disease, but its application in such cases will not be discussed in this work.

Resection of the elbow and of the knee will be here described because they are typical. When other joints have been injured, typical resection need not, as a rule, be performed, the general directions given as to the treatment of compound fractures, gunshot wounds, joint injuries, etc., being sufficient to guide one in his management of the case.

Excision of the Elbow.— Gunshot wounds or compound fractures complicated by great injury to the articulation are almost certain to become infected in spite of all precautions, and a stiff elbow will, after many weeks of suffering, be the result. Accordingly, when such an injury is encountered, preparations for immediate resection of the joint may be made.

General anæsthesia is necessary. Two good assistants in addition to the one who administers the ether or chloroform are required.

The instruments are a rubber constrictor, a large, strong scalpel, a pair of sharp retractors, a pair of small blunt retractors, a pair of scissors, six artery-forceps, a dressing-forceps, a periosteal elevator or raspatory, a saw (a broad-bladed one is the best), a bone-cutting-forceps, a lion-forceps, needles, and a needle-holder. Ligatures and sutures together with sponges and dressings must not be neglected.

Having disinfected the field of operation, the constrictor should be carefully and evenly applied to a wide surface, with no more force than will be sufficient to completely control the radial artery; for paralysis of the arm and hand, usually due to compression of

the musculo-spiral nerve, is far from rare. It is a good plan to surround the limb with a folded towel, and to apply the constrictor over this. The hand of the patient should be enveloped in a bichloride towel so that the assistants may manipulate it without becoming infected.

While one assistant holds the arm with the joint well flexed, a longitudinal incision down to the bone should be made over the posterior aspect of the humerus and continued along the ulna. This incision will vary in length with the size of the part which is being operated upon, but it should in any case be long enough to permit of easy and safe dissection. In the average adult its length should be about five and a half inches. The lower portion of the triceps and its tendinous insertion will be cut longitudinally. The wound should be held open with sharp retractors while the periosteum is peeled away from the humerus and the ulna. This becomes difficult as the joint is approached, and the scalpel will be required to sever the membrane from the bones. The tendon of the triceps should be cut across close to its insertion, and the ulnar nerve which lies in the groove just to the outer side of the internal epicondyle should, with the tissues covering it, be turned out of its place and held off with a blunt retractor. This nerve ought not to be seen during the operation. The joint should now be entered from behind, the radius and ulna cut loose from their articular attachments, and with the help of the assistant who holds the forearm they should be extruded from the wound. Section with the saw is made while the end of the bone is held firmly with the lion-forceps. Stout gas pliers will substitute fairly well the lion-forceps. The ulna should be divided just below the coronoid process and the humerus pushed out from above as was the ulna from below, just above the epicondyles. The head of the radius may be left or sawn off according to the condition of the surrounding parts. Typically it is removed. During the entire dissection it is of the utmost importance that the periosteum be preserved together with the attachments of the muscles to this membrane.

Having completed the excision, a search for the major bleeding points should be made, "milking" the limb from both directions toward the wound, so that the beads of dark blood may indicate the mouths of the divided vessels. Now, extending the arm, the incision in the skin may be closed by a few sutures placed far apart, leaving a drainage-tube projecting from the cavity through the upper angle of the wound. The limb should be dressed in the extended position with considerable even and elastic pressure over a generous gauze padding, the bandage reaching from the hand to the axilla and being stiffened by a few strips of veneering or other thin wood. The elastic constrictor may now be removed, and the limb kept for twenty-four hours suspended. In this position the drainage opening will be at the lowest point. Immediately after the removal of the constrictor the finger-tips should redden with the return of the blood, and the patient must not be sent to his bed until from this blush it is quite certain that the circulation of the limb has been perfectly reëstablished.

After-Treatment. — At the expiration of from four to six days, provided all has gone well in the meantime, the wound may be dressed and the drainage-tube removed, substituting for it a slip of gauze or a folded piece of gutta-percha tissue. The elbow should now be fixed in the flexed position, and from this time the dressings must be changed daily with a daily change in the position of the joint from flexion at a somewhat acute angle to extension. In manipulating the limb to obtain flexion care should be taken to make traction at the same time, so that the bones of the forearm shall occupy a position somewhat in front of the end of the humerus. Plaster of Paris or a heavy crinoline in the form of a light splint are the best forms of fixation apparatus. The patient should be encouraged to move his fingers from the very first.

Excision of the Knee. — This operation is a good one in adults. In children, typical excision should be avoided, if possible, on account of interference with important epiphyses, and consequent retardation of growth. In addition to the anæsthe-

tist, two trained and one untrained assistant should be present. The list of instruments is as follows: a stout scalpel, a pair of large, sharp retractors, a dressing-forceps, eight artery-forceps, a pair of scissors, a bone-cutting forceps, a pair of long steel hand-drills with the handle, a saw, needles, a needle-holder, and a rubber constrictor. In the absence of the steel drills sharp steel nails, or even thick knitting-needles sharpened at one end, may be substituted. A hammer or mallet will then be needed. The rubber constricting bandage should be applied well up toward the body, and after thorough disinfection an incision should be made from a point just above the head of the fibula round the front of the knee, severing the ligamentum patellæ, and opening the joint. The leg should now be well flexed, so as to expose the crucial ligaments which are to be divided. All the other structures except those posterior to the joint must be cut through, and the tibia pushed out from the soft tissues so that its head protrudes. In performing this manoeuvre the leg must be held so that it is vertical and parallel to the femur, the sole of the patient's foot resting upon the table. With the saw the articular surface of this bone should now be removed in as thin a section as possible, and the femur, protruded in like manner, should be sawn through just above its articular surface in a plane almost parallel to the tibial section when the leg is extended. The sawn femoral surface should, however, be slightly oblique, the inner portion being left a little longer than the outer, so that a normal degree of "knock-knee" will result when the bones are put in apposition. The combined thickness of the bone sections should be measured and carefully noted.

The patella and the quadriceps bursa should be dissected out, and all visible bleeding points carefully secured by the method mentioned above (excision of elbow). Then the limb should be straightened, the sawn surfaces placed in apposition, and two drills or nails inserted, so that they may act as anchors to hold the tibia and femur in their proper relations. A good way is to

bore obliquely through the limb, each drill perforating both bones, as shown in the diagram. (Fig. 88.) These drills are merely to act as a partial support, and the assistant whose duty it is to hold the leg in position should on no account relax his vigilance until the entire dressing is finished. Sutures of silk may now be applied for the apposition of the skin, drainage by tube from each posterior angle of the wound being secured. The dressing should consist of two parts: the first a thick, elastic, aseptic covering of gauze, bandaged in place in the usual manner, and over this a splint made with strips of veneering or other thin wood, held by starch or crinoline bandages over a thick layer of cotton batting (not absorbent cotton), the whole extending from the foot just above the toes to the upper portion of the thigh. The elastic constrictor may now be removed, and the toes watched for the customary blush, while the entire extremity is elevated. The patient may then be put to bed.

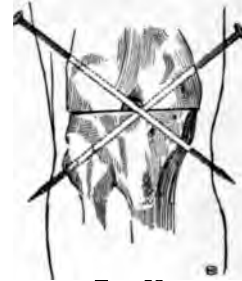


FIG. 88.

After-Treatment. — There is nearly always a rise of temperature after this operation, the thermometer registering as high as 101° or even 102° . By the second or third day, however, if everything is progressing ideally, we should not expect to note an elevation of more than one or two degrees above the normal. Pain is severe for the first twenty-four to forty-eight hours, after which it gradually diminishes until it is insignificant. The first dressing should be left in place, even if there is a little fever (maximum in twenty-four hours say 101°), for from three to six weeks, when it may be cut off and replaced by a firm but less voluminous splint. The wound will be found practically healed, with the exception of the drainage openings and the drill-holes. The drills themselves may now be withdrawn, and it will be noted that no great force is required to do this. Before dressing the limb, a very gentle motion made, as if to flex the knee, will give information as to the degree of bony consolidation. If this seems to be progressing

satisfactorily, a shoe with the sole thicker than that of its mate by the thickness of the bone removed at the operation should be worn, and with the help of crutches the patient will gradually accustom himself to bearing his weight upon the limb. There is usually great timidity, but the exercise is of much benefit, because the pressure tends to hasten consolidation.

Edema will frequently be noted when the supporting splint is left off; bandaging from the toes to the upper part of the thigh, together with daily massage, will, with the natural exercise of the part, cause this symptom to subside.

CHAPTER X

THE THORAX

Wounds of the Chest Wall. — When these do not penetrate the pleural cavity or mediastinum, they should be treated on general principles according to their character as punctured, incised, lacerated, or contused, and as clean or infected. Compound fractures of the ribs, where the thoracic cavity has not been invaded, demand operation for drainage and the trimming off of sharp spicules of bone, which are liable to cause pain or further injury. Gunshot missiles which are non-penetrating may take a remarkable course, so that without the use of the X-rays it may be impossible to locate them. This is the case, however, principally with lead projectiles fired from the older arms. The steel-clad modern bullets almost invariably take a straight course and perforate the chest, doing damage according to the structures which they meet in their flight.

Penetrating Wounds. — Punctures of the chest are not apt to do serious harm, unless the heart or the great vessels have been injured, when death usually follows within a few moments. Even gunshot wounds, if made with bullets of small caliber, may be considered to follow this rule. If the pleura is wounded, air is likely to be drawn into the cavity by the movements of respiration, though this is not necessarily the case, since the wound of entrance may be valve-like in character. If the lung has been injured, there is considerable shock, often accompanied by hemoptysis and dyspnoea; while air may enter the pleura from the lung or from a bronchus, as well as from without. When an intercostal artery has been

wounded, hemorrhage may be very severe, yet concealed, the pleura filling with blood, and the symptoms of collapse at last calling attention to the condition of things. On percussion, dulness or flatness will be noted over a portion of the chest, with absence of respiratory sounds.

Contusion of the Chest Wall may be accompanied by fracture of the ribs with penetration of the pleura, wounding of an intercostal artery, and wounding of the lung by sharp fragments of bone, so that hemo-pneumothorax may be present, and all without an external wound.

Whenever there are symptoms of hemorrhage into the pleura following traumatism by which an intercostal vessel may have been injured, the attempt should be made to find the bleeding point and ligate it. Chloroform should be very carefully administered. The arguments in favor of local anæsthesia are doubled if there is hemoptysis.

One skilled and at least one unskilled assistant should be present in addition to the anæsthetist, though a greater number of helpers may be found useful. The instruments are a scalpel, large, sharp retractors, six artery-forceps, scissors, a dressing-forceps, a periosteal elevator, a bone-cutting-forceps, needles, a needle-holder, and a keyhole-saw or a scroll-saw, with ligatures, sutures, sponges, and dressings.

If the patient is in a condition of serious shock, intra-venous saline infusion should be performed before the operation. Having, by inspection, palpation, and auscultation¹ ascertained the probable location of the bone injury, an incision at right angles to the ribs should be made over this area, long enough to render the damaged region easily accessible. Later, the wound may be enlarged still further if it seems advisable. Having exposed the fractured ribs, the periosteum should be incised in the long axis of that bone which seems the most injured, and, when the outer

¹ The stethoscope applied over the fracture will often transmit to the ear the sounds of bony crepitus.

surface of the rib has been stripped, the elevator or some similar instrument should be used to worm its way between this membrane and the posterior surface of the rib, thus isolating the bone from its coverings and from the intercostal vessels. (Fig. 89.) Holding the rib in position with the elevator, the forceps or the saw may be placed alongside this instrument, and the bone divided. As much as seems necessary may thus be removed, when it will be easily seen whether the intercostal vessels of this particular rib

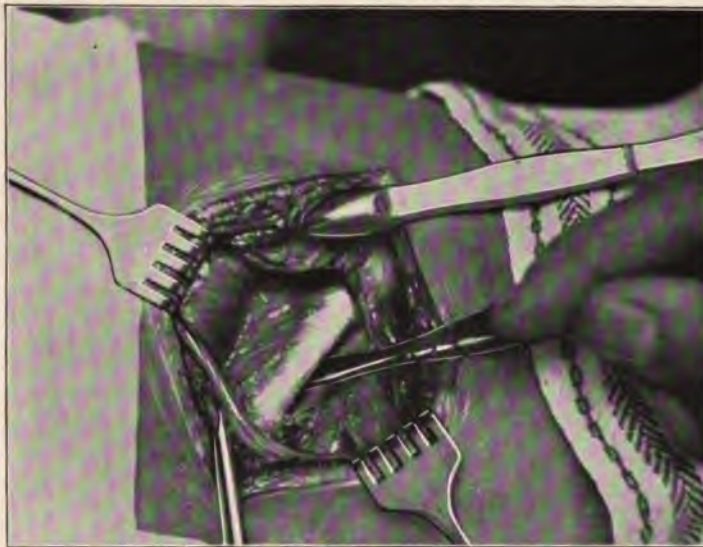


FIG. 89.— Rib exposed. The elevator is separating the periosteum and intercostal vessels and nerve from the posterior surface of the bone.

are injured or not. If they are intact, the neighboring injured ribs must be resected in turn in a similar manner, until the bleeding vessel is discovered, when it should be secured by ligation. The pleural cavity should now be opened freely, ligating other intercostals if they are in the way, and irrigated with saline solution to rid the cavity of fluid and coagulated blood. One or two good-sized drainage-tubes should be placed just within the pleura, and the greater portion of the cutaneous wound sutured and cov-

ered with a dry dressing which need not be disturbed for four or five days. As soon as granulation is established and the secretion has become scanty, the tubes may be permanently removed. Occasionally there is some necrosis of the rib, but it is usually best to allow spontaneous exfoliation to take place.

Acute Suppurative Mastitis. — This form of inflammation occurs nearly always as the result of infection through the nipple and milk-ducts. It affects one or more lobes of the gland. There is induration and intumescence with œdema of the overlying integument. There is apt to be a chill followed by pain and tenderness, together with elevation of temperature. After a time the skin becomes dusky or red, and fluctuation appears.

Treatment. — Evacuation of the pus cavities by incision should be accomplished with as little delay as possible. General narcosis should be employed unless the abscess is very small, when eucaïne anæsthesia will suffice. There should be a single trained or untrained assistant besides the anæsthetist. The list of instruments is a scalpel, a pair of medium-sized sharp retractors, a dressing-forceps, a sharp spoon, scissors, a large-buttoned probe, and four to six artery-forceps. Incisions should radiate from the nipple, so as to avoid undue severing of the ducts, and should, if possible, avoid the areola. The first opening should be made at the most superficial point, where fluctuation is plainest. Having evacuated this pocket, the finger may be inserted for exploration, and any other pockets thus discovered slit up from without on a probe, as described in Chapter VI., under the heading of "Phlegmon." Lastly, massage of the entire gland should be made, watching at the various incisions for the appearance of pus, which would indicate an undrained pocket, which must be carefully sought and opened. All suppurating cavities should be thoroughly curetted with the sharp spoon, and drained by tubes left in until granulation has commenced, when they may be discarded, and agglutination of the walls of the cavities encouraged by elastic compression, preceded, if the granulations seem to be anemic or indolent, by another cu-

retting without anæsthesia. The compression may be accomplished by elevating the breast so that the nipple is exactly in the centre, covering the entire region with a folded piece of gauze, upon this laying a large sponge which has been wrung out in some mild antiseptic lotion, such as the acetate of aluminium solution, and covering the whole with a firmly applied bandage. The sponge must be kept moist, and should remain in position for three or four days, unless symptoms arise which call for a change of dressing. At the end of this period it will probably be found that nothing but superficial granulating wounds remain.

Submammary Abscess. — It sometimes happens that through an infection the space between the mammary gland and the pectoral fascia becomes the seat of abscess or phlegmon. The whole breast then seems to be larger than its fellow, because it is pushed forward by the exudation beneath it. The breast itself is not tender on manipulation, but seems firmly fixed, so that it cannot be moved about upon the chest wall. The suppurating cavity should be drained by one or more generous incisions in the fold below the mamma, not by radial ones, as in abscess of the gland itself.

Acute Suppurative Axillary Adenitis. — The lymph-nodes in the armpit may become infected from the breast, or from the upper extremity. Septic infections of the hand are very commonly to blame for the trouble. There is, at first, a soreness and stiffness without noticeable swelling, except on palpation, when the inflamed nodes may be easily detected, though they are still movable. As the disease progresses, periadenitis supervenes, and there is more or less adhesion, which fixes the nodes to the surrounding tissues, until at last they become matted into a hard, brawny mass. Fluctuation appears late, and should never be waited for.

Treatment. — Free incision and the curetting and packing of the cavity is the only proper treatment after periadenitis has developed. Unless the abscess is a small one, general anæsthesia should be employed. The incision is made parallel with the arm,

and is followed by careful dissection down to the abscess wall, which should be first pricked so that a drop of pus escapes and then widely opened by inserting the closed dressing-forceps and withdrawing the instrument with its blades separated. The curette should be used with some caution so as to avoid injuring important axillary structures. The complete excision of these lymph-nodes should not be undertaken for the cure of acute suppuration unless the case is operated upon very early before periadenitis with general adhesion to the surrounding tissue has occurred.

Empyema of the Pleural Cavities. — This disease is not usually one which would be regarded as urgent from a surgical point of view, but it occasionally happens that the condition has so long remained unrecognized that the patient is in most desperate straits and must be relieved at once.

Diagnosis. — Usually, but not invariably, there is a history of fever and cough with chills and gradually increasing dyspnœa. On examination the respiratory motions of the affected chest are found to be diminished; there is flatness on percussion over a considerable part of one side; the heart may have been pushed out of place by the fluid. The flatness may shift on changing the position of the patient; on auscultation there may be ægophony at the upper level of the fluid. Lastly, the exploratory aspiration with a small syringe and a medium-sized needle made through an intercostal space in the flat area will demonstrate the existence of pus. Even the latter method of diagnosis is not infallible, however, for the pus may be too thick to flow or the aperture in the needle may have become plugged with a bit of tissue or coagulum of lymph. When the case has become truly urgent with dyspnœa, cyanosis, and flagging pulse, the history together with the physical signs form reason enough for operating, even if the exploration by puncture should give no positive information.

Emptying the chest by aspiration should not be attempted, since by the suction the displaced heart is forced back too quickly into its normal position. Sudden death from embolic coagula dis-

lodged from the aorta by the motion are not by any means unknown. Incision, which admits air to take the place of the pus which has been withdrawn, allows the heart to return very gradually, with the healing of the wound, to its proper location, and renders embolism a far less likely occurrence.

Operation.—Local anæsthesia is, on all accounts, to be preferred in operating upon these patients, for ether and chloroform are both particularly to be feared where there is interference with respiration and circulation.

The instruments and the assistants are the same as those mentioned on page 182. More assistants may be found helpful, however, if they are to be had.

Before the operation, the patient should receive an alcoholic stimulant as well as the thirtieth of a grain of strychnine.

He should lie upon the healthy side and, after disinfection, the eucaine or other local anæsthetic solution should be injected in the line of the proposed incision into the skin along the middle of a rib, usually the seventh or eighth, which is well within the area of flatness. The incision, about four inches in length and directly down upon the rib, is best made in the region of the posterior axillary line. If now it is found that there is much space between the ribs, the pleura may be at once incised, taking care not to wound the intercostal vessels which lie in the groove of the rib just within and above its lower edge. If, however, as is usually the case, there is not sufficient room for drainage between the ribs, a section of one or more of them should be removed according to the directions given on page 183. The pleura should then be opened, and tender adhesions, which prevent the lung from coming down, loosened by means of a large-buttoned long probe. After the pus has escaped, the cavity should be irrigated with warm *five per cent.* carbolic solution, which should, in its turn, be immediately rinsed away with saline solution. The patient should be placed in such a position as will permit of the escape of all fluid within the chest, and this position carefully noted and called to the attention of the

nurse. The posture varies considerably with the conformation of the cavity and the situation of the opening, the chest emptying itself in some instances while the patient is comparatively upright, while in others it is necessary to almost invert him to accomplish the same end. Two large-calibered drainage-tubes should be placed with their ends within the cavity just far enough to insure their actually draining, and not so far that by unduly projecting into the chest they may impede the outflow. Now, instead of covering these tubes with gauze placed next to their openings, they should be surrounded



FIG. 90. — "Doughnut pad," or ring of twisted gauze, to prevent pressure directly upon a wound.

with a ring of twisted gauze thick enough to insure the ends of the tubes remaining unobstructed by the dressings laid over this ring. The dressing should be very thick and absorbent. (Fig. 90.)

After Treatment.—The important point in the treatment for the next few days is that the nurse should repeatedly place the patient in the posture which, at the time of operation, was found to drain the chest. If it hap-

pens that this is awkward or difficult, the patient must, nevertheless, be made to assume the posture for four or five minutes at a time, as often as once an hour. It is best that the dressings should not be changed for three or four days, unless the discharge is exceedingly profuse or offensive, or the patient remains in a septic condition. If there is leakage of discharge, more gauze should be bandaged over the spot, and if there is so great a flow that it seems necessary to redress the wound, the outer gauze alone should be changed. When, eventually, the wound is exposed, there should be no irrigation of the thoracic cavity, for this tends to break up

adhesions which have formed between the visceral and the costal pleura, which hold the lung in position, and later, when healing has taken place, become absorbed. If the case is progressing favorably, the discharge will rapidly diminish, so that the tubes may be permanently removed within two or three weeks. If the empyema is tubercular in character, however, the case becomes chronic. It will then be necessary to dress the wound frequently, and to irrigate the pus cavity.

CHAPTER XI

THE ABDOMEN

Penetrating Wounds.— Most penetrating wounds of the abdomen will require operative treatment. It may be impossible to tell, during the first shock after the injury, whether or not a serious hurt has been received; but by the time the preparations for operation are complete, one may form an opinion as to the advisability of surgical interference. In the absence of progressively urgent symptoms, wounds made by missiles from modern small-caliber firearms should not be treated by laparotomy, while most other penetrating wounds should be so treated.

On first seeing the patient, it is well to ascertain, if possible, how the wound was inflicted, so as to be able to form some idea as to its direction and extent. Its location and character should be carefully noted, together with the presence or absence of external bleeding. The patient's aspect and general condition should also be marked. Observation of the pulse, respiration, and temperature should be made, giving the greatest attention to the pulse and respiration, as diagnostic of possible hemorrhage. The escape of gas, or the presence of characteristic intestinal or fecal odor about the wound is of importance. Rapidly appearing tympany over the liver indicates intestinal perforation.

In operations involving the abdominal cavity, it is best to be prepared for any emergency. Such operations resemble the carrying on of a war where all sorts of unexpected contingencies and complications may arise. The first requisite is a sufficient number of assistants, and there should be at least three besides the anæst-

thetist. Two will help at the wound, and the third will be needed for general work in handling furniture, changing solutions and lending an undisinfected hand where it may be needed.

There should be plenty of hot and cold boiled water in the vessels in which it was boiled; three dozen clean towels; two sterilized basins for hot water in which to keep large and small pads of gauze, to be used in the abdomen; two other basins with boiled water for the sponges, and one for the water in which the surgeon and the assistants may rinse their hands when necessary. There should be gauze for sponging and for the dressings; a piece of gutta-percha tissue about a foot square which must be scrubbed on both sides with soap and cold water, and then immersed in cold bichloride of mercury, one to five hundred, and lastly rinsed in cold sterilized water. Fine and medium catgut and coarse and fine silk must be at hand. The utensils for holding the instruments, ligatures, etc., are to be prepared and disposed as described in Chapter IV.

The instruments which should be ready in cases of abdominal section are approximately those mentioned in the following list; but it must be remembered that a makeshift will often be of service in the absence of the proper instrument. For example, a red-hot poker may take the place of the platinum cautery; a bullet-forceps, a dressing-forceps, and a uterine dressing-forceps, all make good sponge-holders.

List of Instruments. — Scalpels, straight scissors, strong, curved scissors, a dozen artery clamps, two or more long clamps, anatomical or thumb forceps, two mousetooth-forceps, a sharp razor, broad, sharp retractors, broad, blunt retractors (see pages 2 and 3), probes (one with an eye), needles of various sizes, needle-holder, sponge-holders, aneurism needle, aspirating needle and syringe, clean hand-scrubbing brushes, and last, but very important, the apparatus for saline infusion.

While the preparations are going on, it is necessary to have the patient carefully watched, and, should rapidly progressive evil

symptoms make their appearance, such, for example, as the vomiting of blood or the signs of concealed hemorrhage (see Chapter IV.), it is best to hurry, even at the expense of antiseptic precautions, for it is better to give the patient a chance to fight sepsis than to permit death to occur from acute anæmia.

The stomach should not be washed out, for it may have been wounded, and the washing fluid may disseminate septic matter through the belly. The anæsthetist should be warned that in case of vomiting there is danger that vomited material may be drawn into the lungs.

When a wound of exit as well as of entrance is present the two should be treated, other things being equal, in the order in which they occurred; but if one wound is bleeding and the other not, or if there is fecal or intestinal odor about the one and not the other, it will be wisest to attend first to the one where the indications for intervention are the more imperative.

Having disinfected the field of operation, a probe should, with a very light hand, be introduced into the wound in order to show its general direction; but it is not desirable to allow the instrument to pass entirely through the abdominal wall. The entire tract of the parietal part of the wound must now be laid open with a scalpel, and the lips of the incision held apart with retractors. This incision should never be made by inserting the knife into the wound and cutting toward the skin, but it should be made according to the principles of correct dissection, from the skin to the deeper parts. In this way every structure is exposed to sight before it is cut. The tract of the wound in the belly wall may now be examined, and all foreign material removed by scrubbing, or even by cutting away the parts which are probably infected.

When the exploration of the parietal perforation shows that the abdomen has been actually invaded, the wound, immediately after its disinfection, should be plugged with a long strip of gauze, leaving the end protruding in order that it may not slip entirely

within the belly, and then another opening, through which to work, should be made beyond the deeper end of the wound, and in such a direction as is usually elected for abdominal section in the region which is to be explored. (Fig. 91.) It is best to make this opening at least four inches in length in the beginning, for now, if ever, one should actually *see* the condition of things, and should on no account be satisfied with working in the dark. Every bleed-

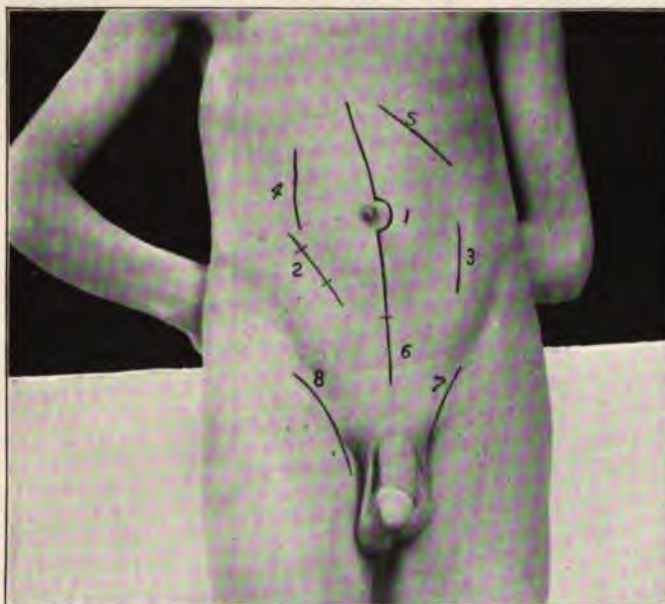


FIG. 91.—Lines for abdominal section. 1. General. 2. One of the incisions for reaching the appendix. The usual one is more nearly vertical. 3. Colostomy. 4. For cholecystotomy. 5. Gastrotomy. 6. Continuation of 1. 7. Inguinal herniotomy. 8. Femoral herniotomy. The homologue of 3, on the right side, would be the incision for right colostomy into the ascending colon.

ing point should be stopped before entering the peritoneal cavity, and when this has been accomplished the peritoneum should be slit to the full extent of the rest of the wound. Large, blunt retractors should now be inserted, the lips of the wound separated, and the abdominal walls, at the same time, raised up away from

the viscera. (Fig. 92.) Great care must be observed, when the retractors are inserted, that no intestine or omentum is caught and bruised.

If, immediately on entering the abdomen, a large quantity of clotted and fluid blood is encountered, the incision should be at once enlarged to six or eight inches, and the blood rapidly wiped away. If the bleeding point cannot then be seen, and the hemorrhage seems to be serious, it is best to eviscerate at once, laying the intestines upon a wet, hot



FIG. 92. — Exposure of viscera *in situ*.

towels upon a wet, hot towel on the patient's abdomen, with as little tension as possible on the mesentery and other attachments. The viscera must be covered with another towel, and frequently moistened with hot saline solution by an assistant, who pours the fluid over them from a pitcher. The bleeding points will now, probably, be seen, and must be dealt with according to their

character. Hemorrhage from a vessel in the intestinal wall, mesentery, or omentum may be stopped by an encircling suture or by ligation over an artery clamp; while bleeding from a solid viscus, such as the liver or the spleen, may require the application of a number of hemostatic sutures, or of a gauze packing. In the case of injury to one of the vessels at the back of the abdomen, it may even be wise to secure it with a clamp, leaving the instrument *in situ*, projecting from the wound, for forty-eight hours, or longer, when it may be cautiously removed. The ligation of vessels so

deeply situated is often extremely difficult. When packings have been left in, and signs of local or general peritonitis remain absent, the gauze should not be removed for at least five days, and even then it is best to do it at several sittings, first loosening it at one point, then at another, until it can be removed without causing hemorrhage, or dragging the viscera into the opening. If no further injury exists, the wound in the abdominal wall may be closed, except at those points where the packings have been left. If the patient's condition is at all critical, the suture had better be made with a single set of thick silk or silkworm-gut button stitches, which must be passed through the skin, fasciæ, and peritoneum. These sutures are not to be fastened until they are all in place. To keep the omentum and intestines out of the way during the suture, a layer of folded gauze may be tucked over them just within the peritoneum, to be removed just before the last sutures are tightened. During the tying it is necessary to ascertain that peritoneum is in contact with peritoneum. The finger placed in the wound, with the volar surface of its tip upon the inner part of the suture, will be able to detect whether or not things are as they should be. If the patient is in good condition, the edges of the wound may be more neatly adapted by means of an additional set of fine silk sutures.

The abdominal wound having been closed, the entire neighborhood should be wiped clean with a wet towel, and the dressings applied. The first dressing of a wound of this kind should be dry, but if there has been suppuration, this dry dressing should be converted into a wet one after twenty-four hours. In applying the dressing a piece of thoroughly aseptic material, gauze, if it is at hand, should be folded into a pad a little longer than the wound, and over this several large pieces of loose gauze should be placed, so that firm and even pressure may be made. Upon this loose gauze a large, smooth pad should be laid, and over this "laparotomy straps" of adhesive plaster are to be fastened. They should be long enough to reach well round upon the flanks. Stout tape

slipped through an opening in each strap permits of its being fastened to its fellow. (Fig. 93.) Over all a binder or a wide roller bandage must be neatly applied. It is in the fastening of



FIG. 93. — Application of "laparotomy straps" of adhesive plaster and tape over the dressing of an abdominal wound.

such dressings during narcosis that the accident of transfixing the skin of the patient with a pin is most likely to happen. It is quite inexcusable.

Traumatic Perforation of Viscera. — Perforating injury of the alimentary tract is usually accompanied by considerable shock. A fecal odor at the wound is indicative of perforation of the large intestine. The presence of inodorous gas in the abdomen shows that the small

intestine high up has probably been perforated. The vomiting of blood after a wound of the abdomen should cause the suspicion of injury to the stomach, while bloody stool is a sign of wounded intestine. The character of the blood may indicate whether large or small gut is implicated. The rectum, or at least the anus of the patient, should be examined, however, as to the existence of hemorrhoids or ulceration, which might be the cause of the bleeding. When there is suspicion of perforation of the alimentary tract, no enemata should be given, for fear that the fluid might enter the peritoneal cavity.

Stomach. — Perforations of the stomach should be at once closed by suture. Having exposed the organ by a median incision ex-

tending from just below the ensiform cartilage to an inch below the navel, the abdominal walls should be well raised up and separated with large, blunt retractors, and the stomach inspected. Any escaped gastric contents should be wiped away, and the injured part of the stomach drawn out of the incision, if possible, and surrounded with gauze packings to protect the rest of the abdominal cavity. If there is an injury in the posterior wall of the organ, it must be reached through an opening in the omentum, or through the mesocolon. To reach the stomach through the mesocolon the transverse colon and the omentum must be turned upward. The perforation found, its edges should be examined for bleeding points which must be clamped and ligated. Then it may be sewn up, with its edges turned well into the gastric cavity, using fine but strong silk interrupted sutures and putting in two or even three layers, because the stomach is a muscular organ which by its contractions may tear out the sutures. While placing the sutures the perforation should be temporarily plugged with a strip of gauze, so as to prevent the escape of the visceral contents. (Fig. 94.) The sutures should have a firm hold in the serous and muscular coats of the stomach, while they must on no account pass entirely through its walls. Having closed the gastric perforation, the stomach may be dropped back into the abdomen and the belly walls closed by heavy silk sutures as already described. If a long time has elapsed between the injury and the operation and much foreign matter was found in the peritoneal cavity, peritonitis, or the formation of intra-peritoneal abscess, is to be feared. Under these circumstances it is better to drain the wound, accomplishing the desired end by means of cigarette drains



FIG. 94. — Part of a row of sutures to close an opening in a hollow viscus. Gauze packing to prevent escape of contents.

of gauze covered with gutta-percha tissue, carried down to the supposed points of infection, to be removed in three or four days. If pus is already present, the entire wound had best be left open and stuffed with gauze; but it is not well to leave gauze strips lying in various directions through the abdominal cavity for fear of subsequent intestinal adhesions. (See peritonitis, Chapter XVI.)

Traumatic Intestinal Perforation.— Perforating wounds of the intestine should be carefully closed by two layers of interrupted fine silk sutures, bringing the peritoneal surfaces in contact. No suture of the outer layer should perforate the mucous membrane. (Fig. 95.) When one perforation has been repaired, it is necessary

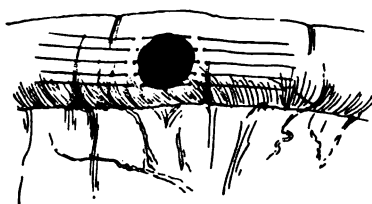


FIG. 95. — A single row of sutures for closing perforation of the intestine. (Diagrammatic.)

to look carefully for others, going over the whole intestine very thoroughly. The inflation of the intestine by air may be accomplished through one of the punctures or even through the rectum with the aid of a rubber atomizer-bulb, an inverted mineral-water syphon, or even a bicycle pump; and the presence and

location of any fairly large perforation will be announced by bubbling or hissing.

Resection of Intestine.— When so much of the intestinal wall has been injured that it cannot be repaired in the way just described, or when the mesentery supplying a coil has been so far destroyed that the vitality of the loop is compromised, it is best to cut out the damaged portion altogether. The injured portion of the bowel must be brought out of the wound, if possible, and well surrounded with gauze; or, if the mesentery is too short for this procedure, gauze packings in the peritoneal cavity must be arranged so as to isolate the coil upon which the work is to be done. Slips of gauze should be passed through the mesentery with the help of anatomical- or dressing-forceps, and tied not too tightly around the gut about five inches from each end of the part to be resected.

The object is to prevent the passage of intestinal contents which would interfere with the work of suture. (Fig. 96.) A triangle of mesentery having its base at the condemned gut should now be tied off with catgut ligatures in such a way that the ligature shall include every vessel in each side of the triangle. Beginning at the apex of the mesenteric triangle, the entire wedge should be cut out

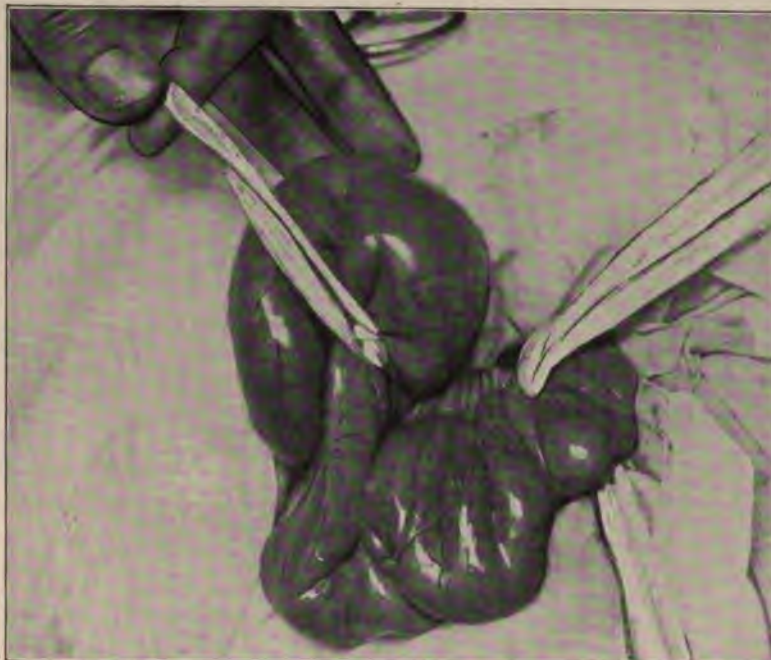


FIG. 96. — Resection of intestine. Gauze fillets through the mesentery. The left one is tied, the right one has not yet been tied. Note the distention of the coil of bowel above the left ligature of gauze.

with strong scissors, and lastly the damaged intestine should be excised in one piece with this mesentery. The intestinal lumen down to the gauze ligatures should be wiped out as clean as possible with bits of sponge held in forceps, and these sponges at once thrown away so that they may not by accident be used again, while the forceps should not be used again until they have



FIG. 97.— Triangle of mesentery and piece of gut have been cut away. Three anchor sutures are here shown.

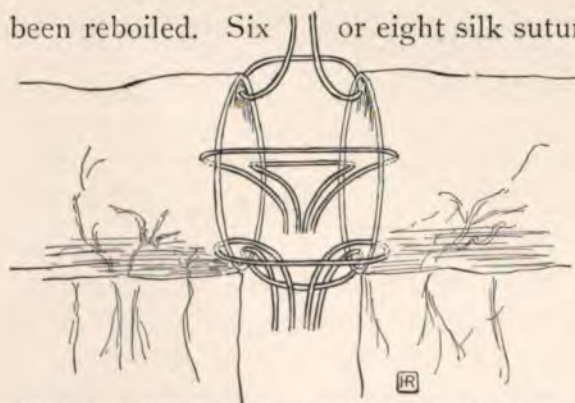


FIG. 98.— Diagram of anchor sutures. The knots will come inside the lumen of the gut.

been reboiled. Six or eight silk sutures may now be put in to draw the cut ends of the intestines together. These so-called anchor sutures should pass through all the coats of the bowel, and should be tied with their knots in the intestinal lumen. (Figs. 97 and 98.) Special care should be taken

with the mesenteric side of the gut that the adaption may be perfect and that no mesenteric vessel may be occluded by a suture.



FIG. 99.—Non-perforating intestinal suture for the approximation of peritoneal surfaces to each other.

One or even two rows of non-perforating fine silk sutures may next be put in to bring the respective peritoneal coats of the ends of the gut into accurate coaptation, so that there shall be no leak. (Figs. 99, 100.) An ordinary straight cylindrical sewing needle is well adapted for this work, because it will not cut the tender intestinal wall. The mesenteric wound must now be sewn up, but no vessel included in the suture. (Fig. 101.)

The gauze fillets may now be removed and a wick of gauze covered with gutta-percha tissue carried down to the line of union and left protruding at the wound.



FIG. 100.—Diagram of non-perforating intestinal suture.

The advantage of this drain is that in the event of accidental leakage there will be a track down to the seat of trouble, instead of a true abscess, which might require a second abdominal section for its evacuation.

Wounds of the Pancreas will probably not be recognized before operation. Other viscera are usually injured at the same time. Pancreatic fluid, flowing out at the drainage opening, may be rec-



FIG. 101.—Half the circumference of the bowel has been sutured. Stitches are being taken in the mesentery.

ognized by its clear appearance, its alkalinity, and the fact that it easily digests albumen and emulsifies fats. Pancreatic fistulæ are obstinate, and if the patient's nutrition seems to suffer on account of the loss of the fluid, glycerin extract of pancreas should be given by mouth, combined with bicarbonate of soda. From ten to twenty grains of the powdered preparation may be given in glycerin with meals, if the glycerin extract cannot be obtained.



FIG. 102. — Remainder of the circumference sutured and anastomosis completed. The gauze fillets have not yet been removed, so the intestine between them is still collapsed.

Wounds of the Gall-Bladder. — Perforating wounds of the gall-bladder should be closed by suture, after a thorough wiping out of all probably infected parts of the abdomen. These sutures should bring peritoneal surfaces in contact, and it is best to leave the abdominal wound open, placing packings down to the injury in the viscus. The presence of bile in the abdominal cavity is not necessarily followed by fatal peritonitis.

Before closing any abdominal wound, when there was extravasation of blood or other fluid into the peritoneal cavity, wiping out the pelvis with a sponge in a holder should on no account be omitted, and if fluid, known to be septic, is found here, a gauze cigarette-drain should be carried down to the very bottom of the cavity and left there for several days.

After-Treatment. — Complete rest, or as near an approach to it as possible, is the rational treatment for at least forty-eight hours after any injury involving a perforation of the alimentary canal; and in carrying out this treatment, the use of opium is practically indispensable. Morphine in frequent small doses should be given

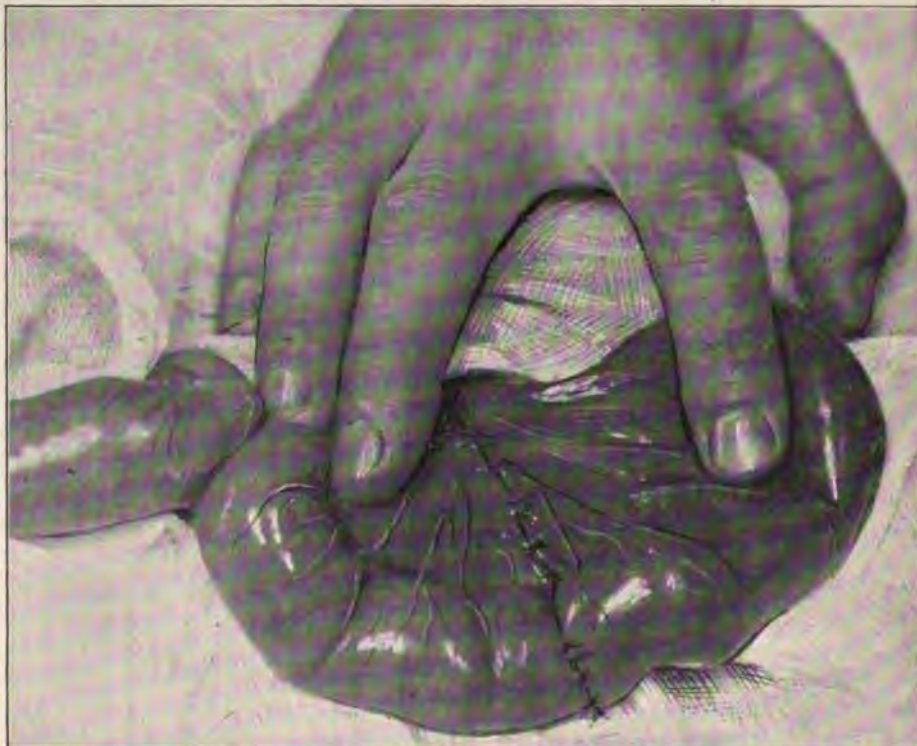


FIG. 103. — The gauze fillets have now been removed, and gas and bowel contents from above have distended the intestinal canal.

in order to check peristalsis. The patient's respiration should be kept down to fourteen or even twelve per minute, and the pupils well contracted. For the first two days nourishment must be given by the rectum, unless, indeed, the colon itself has been injured, when the patient may be permitted to take frequent small quantities of easily digested liquid food by mouth. In feeding by

nutritive enemata, it is necessary that the rectum should be washed out beforehand, and that only easily absorbable food material should be used, the enema being warm and of not more than four ounces in bulk. The rectum absorbs, but it cannot really be said to digest. Peptonized milk, meat peptone, and raw egg beaten up with diluted brandy are some of the things which are useful for this purpose. When irritability of the rectum is feared, ten or fifteen minims of the tincture of opium may be thrown in with the alimentation.

If there was no perforation of large intestine the bowels may be moved on the third day, and in order to avoid undue straining, six ounces of warm olive-oil should be injected, to be retained for three or four hours, when it may be followed by a warm soap-and-water enema. On the fourth day a gentle cathartic may be administered to move the bowels from above. Where the colon or rectum has been perforated from without, the patient should be absolutely constipated for from six to ten days. A series of enemata with oil and water should then be administered before purgation from above is attempted.

The abdominal sutures should not be taken out until the twelfth or the fourteenth day, unless suppuration necessitates their earlier removal. The adhesive straps and binder must be worn until the wound is soundly healed, when an abdominal supporting belt will be found comfortable, as well as useful in preventing the occurrence of ventral hernia.

Should a biliary or a fecal fistula of small size persist, there is a fair probability that it will eventually close. The cure may often be hastened by repeated cauterization of the orifice with a red-hot metal point. Fistula into the small intestine may require further operative treatment, which need not be here described.

Persistent vomiting is one of the worst symptoms which may occur after abdominal section. It often indicates the existence of dangerous tension in a vital organ, such, for example, as obstruction of the bowel by adhesion or by distention due to intestinal paresis. When frequent vomiting continues for more than twenty-four hours

after abdominal section, in spite of the fact that no food has been taken, and when this symptom is accompanied by a weak, rapid, or irregular pulse and an anxious facial expression, it is best to move the bowels as soon as possible. A quarter of a grain of calomel in tablet-triturate form every ten minutes until two grains of the drug have been taken, may be followed by an ounce of the fluid citrate of magnesia every ten or fifteen minutes for six or eight doses. Should catharsis begin sooner, the medication should cease. If, now, the vomiting continues or even becomes worse, the wound must be dressed at once, and all packings removed in order to make sure that there is no constriction of any organ at the site of the wound, either between the sutures or by entanglement with the packing. If nothing is found to account for the trouble, and the symptoms become steadily more alarming, the reopening of the abdomen for exploration must be considered. If the original wound was a clean one, a simple reopening of the wound by the removal of the sutures may be done; but if there was local sepsis, a median incision will be necessary besides, in order that all parts of the peritoneal cavity may be explored.

The urine should be carefully measured and frequently examined after an abdominal operation, and on the appearance of albumin the administration of opium must be stopped or the doses greatly diminished, while free diuresis should be encouraged. Copious draughts of distilled water, together with the infusion into the rectum of a pint of normal salt solution will be found of value, while among the drugs, the infusion of digitalis alternating with small doses of calomel will act favorably. (See Chapters V. and XVI.) (For diagnosis of wounds involving the bladder, the ureters, or the kidneys, see Chapter XVIII.)

Perforation of the Alimentary Canal by Disease.—PERFORATING ULCER OF THE STOMACH. The perforation of the gastric wall by ulceration is usually preceded for a longer or shorter time by symptoms of ulcer of the stomach. The occurrence of the accident when the perforation takes the acute form and communicates with the gen-

eral peritoneal cavity is usually characterized by sudden and intense localized pain, with the symptoms of severe shock. There may be pyrexia or, at first, a subnormal temperature, with fever as a later condition. The pulse is rapid and small, the abdomen tense, the breathing short and of the costal variety, the face anxious in its expression. Nausea is sometimes present, and occasionally the vomited matter contains blood. Delay, in cases where the diagnosis is clear, is worse than useless. Immediate operation is demanded, with as little previous manipulation as possible. The stomach should not be washed out, nor should medicines be given by mouth. If the patient is not already under the influence of opium, morphine should be given hypodermically before beginning the anæsthetization, in order to abolish, as far as possible, the stage of excitement, and also for the purpose of controlling vomiting in the early part of the narcosis, with the consequent squeezing of gastric contents into the abdominal cavity.

Everything should be prepared as for a perforating abdominal wound. The anæsthesia had better be begun with chloroform, and it will be wise to have the head of the table about four inches lower than the foot.

The incision should extend from just below the tip of the ensiform cartilage down to the umbilicus, enlarging this later if more room is needed, and passing to the left of the navel, so as to avoid cutting through the round ligament of the liver. (Fig. 91.) The anterior wall of the stomach may now be inspected, the edges of the abdominal incision being held apart by blunt retractors. These retractors should raise the tissues while they separate them, for by this manœuvre one is enabled to peer about under the parietes for a considerable distance, without disturbing the viscera. Great care should be taken that no recent adhesion is accidentally broken down. If the seat of the trouble is on the anterior gastric wall, the perforation should be at once plugged with gauze and all foreign matter in the peritoneal cavity wiped away as quickly, but as thoroughly, as possible. The abdomen should on no account

be washed or flushed out, because dissemination of the septic material would be certain, and a consequent general peritonitis very probable; while with the system of wiping, even if some foreign matter should be left, the chances are that adhesions would form and a local abscess result.

If nothing abnormal is to be seen on the anterior wall of the stomach, its posterior wall may be examined through an opening made in the omentum or transverse mesocolon. Having wiped away as much as possible of the foreign matter, the injured portion of the stomach should be carefully surrounded with gauze packings, and the silk sutures inserted in the same manner as has been described above. (See page 197.) It is important to turn in a generous ring of gastric wall, since the ulceration may extend for a space around the actual perforation, and it is advisable to place the sutures in healthy tissues.

When the perforation has been well stitched up, the abdominal wound may be partly closed by sutures, a sufficient opening being allowed for the drainage, through which a slip of gauze should be left with one end at the site of the perforation, and the other end in the abdominal wound, the gauze being arranged in as short and straight a line as possible.

Dangerous Hemorrhage without Perforation. — It occasionally happens that gastric ulceration invades a blood-vessel without perforating the stomach wall. This accident is usually announced by the vomiting of large quantities of blood, with the rapid supervention of the signs of acute anemia, the quick and progressively weak pulse, the sighing respiration, and the great and increasing pallor. Such an emergency should be treated by operative interference, when it becomes evident that the rapid progress of the symptoms cannot be checked by means of rest, cold applications, the swallowing of hemostatic substances, and the administration of opiates. In by far the greater number of cases of hemorrhage from this cause operation is not indicated, and it is a well-known fact that when patients do survive until the bleeding has ceased, their recovery is rapid even after the appearance of very grave symptoms. The

guide as to the advisability of immediate surgical interference should be the apparent rapidity of the hemorrhage, as shown by the vomiting of unchanged blood in large quantities and the *rapid* onset of the symptoms of collapse or the occurrence of several hemorrhages at short intervals.

The preparations for operation are the same as those for cases of perforating abdominal wound. (Page 191.) The apparatus for saline infusion should be at hand. If the condition of the patient is at all critical, an infusion should be performed before operating or by an assistant during the progress of the operation.

The incision and the other steps are the same as those described on page 196 until the stomach has been exposed. The organ should now be carefully drawn out of the abdomen and well surrounded with gauze packings. An opening parallel with the greater curvature and about four inches in length should be made through the anterior stomach wall, all bleeding points being secured, and then the gastric cavity should be exposed with the aid of retractors or by catching the edge of the visceral wound with four artery-forceps held apart by assistants, or by four or more stout silk sutures, inserted with hemostatic needles, the ends of the sutures being left long and held by assistants. All blood and clot should be wiped away, and a search made for the site of hemorrhage. When this can be found, it may be pushed into the wound with the aid of the hand working through the abdominal wound, but outside the stomach, and the vessel tied with silk thread. The ulcer should be carefully inspected and if there are signs that perforation is imminent, it may be excised, previously surrounding it with a row of ligatures passing through healthy tissue. Disinfection by cauterization should not be attempted. If excision has been performed, the wound should be sutured before the closure of the gastrotomy opening. The wound in the stomach wall may now be closed with two or three tiers of interrupted silk sutures put in with the greatest care to prevent leakage, and the abdominal wound sutured with the exception of a short drainage-tract. (Page 208.)

No effort should be omitted to prevent post-operative vomiting, and for three or four days at least food should be given by the rectum only.

Perforation of the Intestine due to Disease.—(For perforation of the vermiform appendix, see Chapter XIII.) The commonest cause of perforation of the intestinal tract by disease is the so-called typhoid ulcer. Perforation in the course of typhoid fever should be treated by operation, unless the patient's general condition is such that the shock of the abdominal section will obviously hasten a fatal issue. In determining the advisability of interference, it must be remembered that the very occurrence of the accident is accompanied by symptoms of severe shock, so that our guide should rather be the condition of the patient during his illness and just before the perforation, than immediately after. If the whole course of the disease has been a severe one, with great weakness and general lowering of the vital forces, an operation will probably hasten the end instead of retarding it; while if the perforation occurs in the course of a mild attack of the disease, the operation will not prejudice the chances of the patient, while it will do away with a part at least of the very grave danger resulting from the accident. The history of the case must, then, be one of our chief guides in determining the advisability of operation.

The occurrence of perforation is indicated by the sudden onset of the symptoms of collapse, frequently ushered in by a chill with a fall in temperature, accompanied by severe and often localized abdominal pain and tenderness. Sometimes vomiting is present, and, as peritonitis develops, this may become a prominent symptom. Distention of the abdomen begins soon after the perforation, and the breathing becomes embarrassed and thoracic. There is an expression of great anxiety in the patient's face. (For typhoid appendicitis, see page 261.) These symptoms coming on in the case of a patient who was not in particularly bad condition just before the time of their occurrence indicate the presence of a perforation which should be treated by surgical measures. When the diagnosis is

once clear, there should be no delay, for the danger of the operation is in direct proportion to the time which has elapsed since the accident.

The preparations are the same as those outlined at the beginning of this chapter. The incision should be made over the point of greatest tenderness, provided this can be accurately located well outside the outer border of one of the recti; otherwise the incision had better be made in the median line, and it should be ample so that work may be done under the guidance of the eye. An incision of less than four inches to begin with will be hardly sufficient. Through this opening the finger should carefully seek any thickening or adhesions, but with so tender a touch that no harm may be done through the accidental rupture of a recently formed abscess-sac. If a thickening or mass of adhesions is detected, it should be carefully brought into the wound, which must be further enlarged, if necessary, in order to avoid any strain to the adherent parts. As soon as the mass is at the wound the rest of the peritoneal cavity should be walled off by gauze packings. Then the adhesions may be separated, and the perforation, if found, temporarily clamped. The septic cavity should be thoroughly wiped out with a small sponge wet in five per cent. carbolic acid, and this should, in its turn, be wiped away with a sponge wet in normal salt solution. The perforation may now be closed by silk sutures as recommended in the case of perforating wounds, and the abscess-cavity packed with gauze, the end of which must be left protruding from the abdominal wound, to be removed and replaced if necessary in a day or two. It is best to have the distance from the perforation to the surface as short as possible, even making another opening through the abdominal wall in a convenient location, if this should be necessary to avoid a long or tortuous channel.

If the exploring finger encounters no thickening and no other evidence of local trouble, the edges of the wound should be held apart with blunt retractors, the abdominal walls being at the same time held off from the viscera, and a search with the aid of

vision should be made. (Fig. 92.) If the perforation happens to be in sight, all intestinal contents which may have escaped into the peritoneal cavity should be wiped away, and the hole in the gut sewn up, as described in the case of accidental perforating wounds, taking great care that the sutures are put through sound intestine beyond the portion of intestinal wall which may have been thinned by the ulcerative process. (Fig. 95.)

If no perforated place can be seen without disturbing the relations of the intestine, it is best to look for the cæcum and then pass the gut through the fingers for inspection from the ileo-cæcal valve in both directions as far as possible; but evisceration is not justifiable, on account of the danger of fatal shock. Indeed, in cases of perforation of any kind it is hardly permissible, unless the condition of the patient immediately before the operation was practically normal. Thus, evisceration for the discovery of a traumatic perforation, where the operation is done soon after the injury, is a proper step, while in cases where the general condition of the patient is wretched because of exhausting disease, evisceration will probably be the factor determining an immediately fatal issue.

CHAPTER XII

INTESTINAL OBSTRUCTION

Intestinal Obstruction.—This serious malady may arise from various causes, such as fecal impaction, volvulus, intussusception, constriction by bands or adhesions, by occlusion of the lumen of the canal by tumors within or without the intestine, by the slipping of a knuckle of intestine through a slit in the omentum or mesentery, and by the strangulation of a hernia. Two or more sites of obstruction may exist coincidentally.

Intestinal obstruction may be divided into two classes: the slowly progressive or the chronic and the rapidly progressive or acute. The symptoms may indicate complete or only partial occlusion in either the chronic or the acute form. The chronic form is exceedingly apt to assume suddenly an acute aspect.

Diagnosis of the Acute Variety. — The mere fact that the bowels have not moved for a certain period, in spite of the usual remedies, is not of itself sufficient evidence upon which to base a diagnosis of this condition. On the contrary, certain cases of complete intestinal obstruction are accompanied at first by diarrhœa, or by the appearance of more or less normal-looking stools coming from the lower, unaffected portion of the bowel. The more prominent and important symptoms of intestinal obstruction are due not only to occlusion of the canal but to the strangulation of a vital organ, the absence of stool or flatus being important corroborative evidence of the condition. The symptoms are griping or colicky pain, usually over a considerable portion of the abdomen, and of an intermittent character, nausea and vomiting, the presence of localized tender regions in the abdomen, the exist-

ence of abdominal tumors, or masses which are usually tender on palpation and often tympanitic on percussion, rectal tenesmus with the occasional appearance of blood or bloody mucus in the stool, a normal or but slightly elevated temperature, a weakened and usually accelerated pulse, and a peculiar, anxious facial expression. The vomiting is a fairly constant symptom, appearing early, according to the distance of the obstruction from the stomach. At times there is much nausea, while again the vomiting may partake of the character of regurgitation without nausea. The vomited matter consists at first of partly digested food, while later, biliary and intestinal secretions appear, and when the large intestine is involved, actual feces may be vomited. Digital exploration of the rectum should always be performed. When intestinal obstruction remains unrelieved, peritonitis, at first local, and later general, occurs. Rarely the pathological condition becomes corrected spontaneously, but this happy solution of the trouble should never be expected or waited for. As a rule to which exceptions are almost unheard of, acute intestinal obstruction is, from the first, a surgical disease.

When acute obstruction supervenes upon a chronic condition of a similar nature, it is really due to the fact that a partial occlusion of the intestinal lumen has become complete. The acute symptoms have generally been preceded by constipation, alternating with diarrhœa, the fluid feces finding their way, for a time, past the obstruction.

Treatment. — The only indication is to restore, without delay, and with as near an approach as possible to the normal conditions, the permeability of the intestinal canal. Any method of procedure which fails to accomplish this object is at best but a makeshift, and often a poor one. Whatever else we may hope to accomplish by surgical operation, the strangulation must be relieved before the patient leaves the operating-table.

Operation. — When the patient is in fair condition, general anæsthesia should be employed, but when the pulse and respiration are of such a character as to indicate immediate danger, local

anæsthesia with eucaine should be preferred. The assistants and the instruments have been enumerated in the preceding chapter. If general narcosis is to be employed, the patient's stomach should be washed out beforehand. This is an extremely important precaution in this class of cases, for the constant regurgitation of fluid, often septic in character, is almost certain to be accompanied by aspiration of the vomited matter into the lungs, an accident which will quickly prove fatal.

Palpation in anæsthesia will frequently be found of great value, tumors and masses being readily distinguished which it was impossible to detect during consciousness. This method of palpation should never be omitted whenever anæsthesia has been found necessary. If a tumor or an increased local resistance can be discovered, the incision had better be in its neighborhood; but if palpation gives no information as to the locality of the obstruction, the opening should be made in the linea alba, passing around the umbilicus to its left side. The various layers of the abdominal wall should be successively incised, while they are raised up away from the viscera, between two mousetooth-forceps held respectively by the operator and the first assistant, the edges of the wound being retracted by the other assistants. (Fig. 111.)

When the peritoneum has been incised, the presence or absence of pus or of other free fluid or of lymph-coagula should be noted, as well as the condition of the intestinal wall. Purulent fluid or even a considerable quantity of slightly cloudy serum is an indication that peritonitis is already present. It is an omen of grave import. The aperture should at first be made large enough to admit two fingers, which should explore in all directions as far as they can reach, with the object of detecting a tumor or a band or other constriction. If this manœuvre is not successful, the opening may be enlarged in both directions and the presenting omentum pushed up out of the way with a sponge on a holder or with a strip of gauze, the end of which must be allowed to protrude for a considerable distance from the wound, the proper method with all

packings in the abdomen, in order to avoid the accident of unintentionally leaving a foreign body within the peritoneal cavity. Coils of intestine will now appear, some collapsed and some distended. If the patient is in such a wretched condition that his death on the table is to be feared, it is best not to proceed further at this time, but to withdraw a distended loop from the wound and having isolated it thoroughly from the peritoneal cavity, by well-placed gauze packings, to incise it longitudinally at the part which is farthest from the mesentery, turning the patient upon his side so that the intestinal contents shall escape freely into a basin. (Enterotomy.) A stitch or two may be put in so as to close, at least temporarily, the opening in the bowel, and the patient may then be sent to bed. If he improves, further efforts to find the obstruction may be later made, or it may be found necessary to open the protruding coil of gut once more, leaving it open this time. (Enterostomy.) If the condition of the patient warrants proceeding with the operation without incision of the intestine, the next step will be the search for the obstruction, remembering that the distended intestine must be above the seat of the trouble, and the collapsed coils below it. Distention of the colon and small intestine means that the obstruction is low down, while collapsed large intestine occurring together with considerable collapsed small intestine, means that the impediment is nearer the pylorus. It is good practice to examine by palpation or, better, by inspection, the large intestine first. If the distention affects any part of this, the probable location of the seat of trouble is narrowed down to a very small portion of the intestinal canal, and it should be easily found. If the large intestine is collapsed, and the obstruction is not found at the ileocæcal valve, the collapsed small intestine should be explored backward or upward from this valve, removing the coils from the abdomen if necessary, and enveloping them in hot towels. It is unwise to handle the distended gut more than is absolutely necessary, on account of the ease with which its walls, especially the tense peritoneal coat, may be injured.

Having found the site of the obstruction, the possibility of safely getting rid of it must be considered. If it seems necessary to manipulate the distended intestine to any considerable extent, it will be far safer to draw one of the coils out of the abdomen, isolating it with gauze and incising it as described above, until much which was distended has become flaccid, when, after the intestinal wound has been carefully sutured, the gut may be handled with less danger. If gangrene of the intestine has taken place, the entire gangrenous portion should be excised, unless, indeed, the patient is doing badly, when the operation may at any stage be terminated by allowing the coil of doubtful-looking bowel to remain at the wound or protruding from it, with the object of resecting later or of making a temporary intestinal fistula.

When the constriction or other hindrance has been relieved, the portions which were or are distended should be examined to ascertain whether paralysis is present, the wall of the bowel being rather briskly, but bluntly, pinched between the fingers and then inspected to note peristalsis. If paralysis seems to exist, the wound in the abdomen should not be entirely closed, but one of the doubtful coils should be left just within the opening, this part of the wound being packed with gauze. In the event of continued inertia of the bowels, some relief will be afforded by incising this coil so as to form a temporary fecal or intestinal fistula.

In general, coils upon which there are spots of doubtful vitality should be left near the wound, and gauze packings should be carried down so that in the event of a leak there may be a track down to the visceral opening. Where actual gangrene is present, the resection should be ample enough to take in living and perfect bowel at each end of the excised portion.

When no gangrene and no intestinal paresis is present, and the obstruction has been thoroughly relieved, the abdomen may be closed by suture and the patient sent to bed. Having relieved the strangulation, there should be no great haste to move the bowels. Gas and feces will escape naturally, in all probability, but even if

this does not occur the vomiting, pain, and other signs of obstruction will soon vanish. Fluid diet should be given for the first few days, or until the bowels have fully recovered their tone. The sutures in the abdominal wall need not come out for ten days, provided the wound remains aseptic.

Intussusception. — This pathological condition may be described as the invagination or “telescoping” of a portion of intestine into that portion which is continuous with it. A sausage-shaped tumor is thus formed which consists of three layers of intestinal wall, the outer, the middle, which is in reality the reflection of the outer, and the inner. The outer forms a sheath called the intussusciens, while the two inner form the intussusceptum. (Fig. 104.) The



FIG. 104. — Diagram of intussusception.

lumen of the intestine is not necessarily completely occluded by an intussusception, though as a rule complete obstruction soon comes on because of œdema of the intussusceptum.

Two forms of the disease exist, the acute and the chronic. Acute intussusception is commonest in children under one year of age, and it occurs in a very considerable proportion of all cases in children under ten years old. It is rare in young adults, but becomes more common again in the aged.

The cause of the trouble is irregular peristalsis or the presence of polypi or other intestinal tumors, which, being dragged upon by the movement of the intestine, draw the bowel to which they are attached after them.

Sometimes a reversed intussusception is found where the intus-

susceptum is composed of a part of the intestine *below* that which forms the intussusciens.

Anatomically an intussusception may be composed entirely of large intestine, entirely of small intestine, or of both large and small intestine. In the latter case the ileum is usually found within the ascending colon. It should never be forgotten that the finding of one intussusception does not preclude the presence of others. (See general remarks on intestinal obstruction at the beginning of this chapter.)

Diagnosis of Acute Intussusception. — Frequently an attack of diarrhoea with vomiting and progressively increasing tenesmus ushers in the disease; or the diarrhoea may precede and be a causal factor in the production of the condition. The vomiting and straining become continuous and very exhausting, while the discharge of faeces ceases, being replaced by the appearance of mucus, which is often blood-stained. The blood, especially in the case of young children, stains the mucus at first a faint pinkish hue, which later becomes redder. The vomiting may be violent and projectile in character, though in the aged it is frequently more like an actual regurgitation and is accompanied by little effort. Pain, usually referred to the umbilical region, is a very prominent symptom and is intense and continuous, the patient throwing himself about in bed, seldom resting quietly for more than a few minutes at a time. When the tension has been relieved by the sloughing or perforation of the affected portion of intestine, temporary relief occurs as the forerunner of septic peritonitis.

On inspection, the abdomen will be found flat or distended, according to the distance of the obstruction from the pylorus and the duration of the attack. In thin individuals peristaltic movements of the intestines may be visible through the abdominal walls, especially when the obstruction is low down. Palpation may reveal the presence of a tumor often described as "sausage-shaped," but failure to discover such a mass should on no account exclude the diagnosis of intussusception, for a tumor may still be present under the

edge of the ribs, while the tension of the abdomen so frequently noted in these cases, especially in children, may prevent accurate palpation without first putting the patient under the influence of an anæsthetic. Exploration of the rectum with the well-lubricated naked finger should never be omitted, since it may be possible actually to reach and recognize the apex of the intussusceptum, thus making the diagnosis certain. Indeed, the intussusceptum may even protrude from the anus.

Percussion may give no information, or it may be noted that a part of the abdomen is very tympanitic while the remainder is quite dull or even flat.

In arriving at a diagnosis no one sign or symptom, except the unmistakable palpation of the intussusceptum through the rectum, should be a determining factor; but all the phenomena should be carefully considered, each by itself, and all in their relation to one another. Where no accurate diagnosis is possible, but intestinal obstruction is recognized, the duty of the surgeon is nevertheless clear, no matter what the age or condition of the patient, unless, indeed, he has become so weak that his death during the operation may be pretty certainly expected.

Operation.—The assistants, instruments, etc., should be the same as those enumerated on page 191. General narcosis is essential. Before proceeding to anæsthetize, however, one attempt to reduce the intussusception by hydrostatic pressure should be made, in the following manner. Having elevated the foot of the bed, or, if the patient is a child, raising its feet so as to almost suspend it in the inverted position, water from a fountain syringe or irrigator, hung not more than four feet above the patient, should be allowed to flow through the enema tip into the intestine, while gentle massage of the abdomen is practised. This form of treatment is, of course, only to be employed when the diagnosis of intussusception is quite clear, and when a tumor can be felt or the involved gut palpated by the rectum. Success is recognized by the disappearance of the tumor and the immediate relief of

pain. This method of treatment should not, however, be long continued if unsuccessful, for various accidents may occur, as a result of too greatly distending the bowel.

Having decided that operation is necessary, the abdomen should be opened over the tumor, if one is present; if not, then in the median line, the incision passing round the umbilicus to the left. (Fig. 91.) Having found the intussusception, it should be carefully inspected, and if gangrene is present, resection of the affected portion should be at once performed. (Page 198.) If the intestine looks doubtful, gentle attempts to reduce the condition by taxis through the intussusciens may be made, but no attempts by traction upon the unaffected portions of the bowel should be permitted. If this attempt proves futile, resection of the intestine must be done. If the condition, however, is a recent one, and no adhesions exist, reduction by manipulation through the tumor is not difficult. The intussusceptum should be *pushed* out into place through the wall of the tumor. If at any time during the operation the condition of the patient becomes so grave that fears are entertained as to his ability to stand further manipulation, the affected coil should be drawn out of the abdomen as well as possible, and after thoroughly packing gauze about it in such a manner as to protect the general peritoneal cavity, the mass should be longitudinally incised so as to completely relieve the strangulation and restore the normal continuity of the tissues, when, if the intestine is found to be sufficiently healthy, the incision may be closed by suture, while if it is of doubtful viability, the opening may be left in the wound. This formation of an artificial anus or an intestinal fistula, however, should be avoided by resection of the gut if the patient is in sufficiently good condition to permit this longer operation.

Volvulus.— This may be described as a twist of a loop of intestine. It has been called an axial twist of the intestine, but no such thing as a true axial twist is possible in the anatomically normal intestine except at the vermiform appendix. Volvulus is commonest in the aged. Its location is usually at the sigmoid

flexure, and is made possible by the existence of a long mesosigmoid. The point of next frequency is the region of the lower ileum, and the cæcum. Volvulus is often chronic, and very frequently relapsing, whether cured spontaneously by enemata, or by operation. The symptoms of the disturbance are those of intestinal obstruction. On examination pain may be elicited by palpation of the distended loop, and also at the site of the constriction. The history of previous attacks is worth noting.

Operation. — The incision should be made over the region where the tumor is believed to lie. Even when this is in the right side of the abdomen, it is not improbable that we may come upon a volvulus of the sigmoid, the distended loop lying in the right iliac fossa, while the constricted portion is in the left side. In acute exacerbations of chronic volvulus, the gut may be found greatly hypertrophied and, indeed, of enormous size. The incision should be sufficiently enlarged to permit of a good view of the affected parts, so that the direction of the twist may be clearly made out. The correct relations of the bowel having been restored, the convexity of the loop should be fixed to the peritoneum with a few silk sutures, so that the twist may not occur again. If gangrene of the loop or of a part of it has occurred, resection or the formation of an artificial anus will be required; but it must be remembered that it is not sufficient to open the loop itself, but that the intestine above the loop must be incised in order to give relief.

Slit in the Mesentery or Omentum. — It sometimes happens that knuckles or coils of intestine become strangulated after passing through congenital slits in the mesentery or the omentum. This state of affairs cannot be foretold before the operation. The symptoms are those of intestinal obstruction, and the treatment is by operation following general surgical principles. The slit in the mesentery should be sutured with catgut in order that the accident may not recur, while if the omentum is at fault, that portion which contains the hiatus should be ablated, tying it in small sections with fine catgut before cutting it off. Although the deformities

causing this accident are congenital, the disaster may not occur until adult life or old age.

Bands and Adhesions. — Obstruction due to the presence of bands or adhesions may not infrequently be diagnosed by the fact that there has been an inflammatory disease or a surgical operation involving the abdomen at some previous time. If the character of the former disease or operation can be ascertained, additional light may be thrown upon the case. The treatment is abdominal section for the division of such bands or adhesions. This is always best done by division between ligatures, rather than by blunt dissection, unless, indeed, the adhesions are very recent, when blunt peeling away of the implicated viscera is not improper.

After operations for this condition, the bowels should be kept very active for several days, in order to avoid, if possible, the formation of other adhesions at the site of the old ones.

Meckel's Diverticulum. — This congenital pouch, which springs from the lower portion of the ileum, is occasionally the causal factor in intestinal obstruction. It may be implicated in a volvulus, or in an intussusception. The diagnosis is made at the operation. After relieving the constriction the diverticulum should be removed.

Fecal Impaction. — Aged persons are those commonly afflicted with this disturbance. The history is one of constipation alternating with diarrhœa, the patient not feeling well for a number of weeks, or even months, until more or less suddenly the symptoms of intestinal obstruction appear. Sometimes it is impossible to differentiate between uncomplicated fecal impaction and a stagnation of dry, hard fecal masses behind a slowly constricting tumor of the intestine. When acute symptoms appear, however, the treatment is the same, so far as securing immediate relief is concerned, radical measures to effect a cure being reserved for a future operation. When all else has failed, the patient should be operated upon, the first portion of the ascending colon being opened.

Right Colostomy. — General or local anæsthesia will be necessary according to the condition of the patient. There should be at

least two assistants besides the anæsthetist. The instruments are a scalpel, blunt and sharp retractors of medium size, two mousetooth-forceps, six artery-forceps, a thick probe, needles, sutures, ligatures, a needle-holder, and a pair of scissors. Sponges and dressings should be at hand as in every operation.



FIG. 105.—Left colostomy. First step. Suture of peritoneum to skin. The gauze packing prevents prolapse of the viscera.

An incision two and a half to three inches in length should be made through the outer portion of the right semilunar line, and parallel with it, its lower extremity being at the level of the anterior superior iliac spine. Having entered the abdominal cavity, the parietal peritoneum should be attached to the skin by a few

medium-sized silk sutures. (Fig. 105.) A knuckle of large intestine should now be drawn into the wound, and should be recognized as ascending colon, not only by its size and color, its longitudinal striations, and its epiploical appendages, but also by its anatomical relations with the cæcum and the vermiform appendix. This

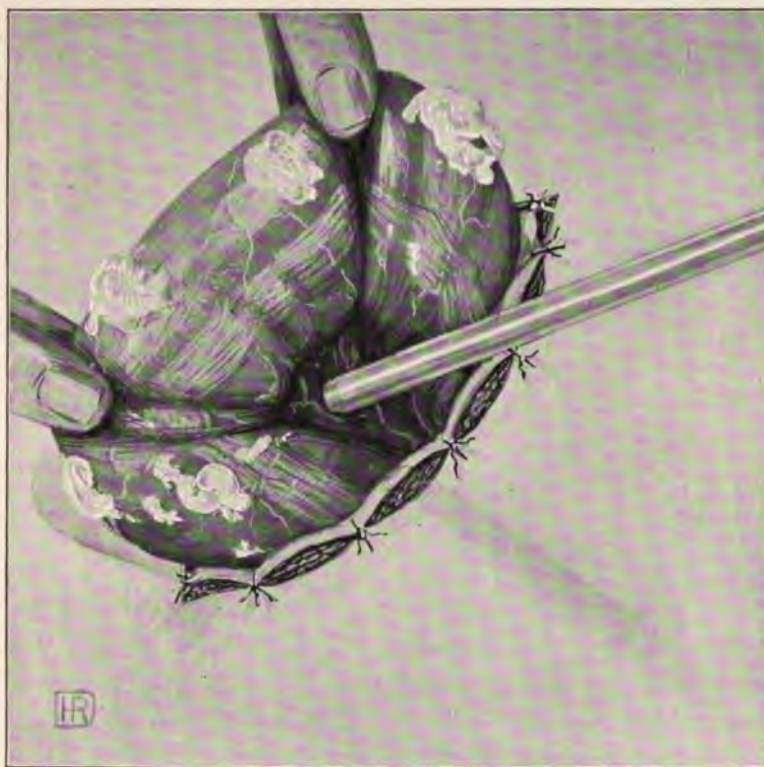


FIG. 106.—Colon drawn out of the wound. A glass rod perforates the mesocolon to hold the coil out of the abdomen.

care is necessary because it is not always easy to otherwise differentiate between the ascending colon and a long sigmoid flexure, which occasionally occupies a position in the right side of the abdomen, overlying the cæcum and ascending colon. Having assured ourselves that the right portion of the intestine has been

drawn out of the wound, a thick probe, a glass rod, or some other smooth object of equal thickness, should be forced through the mesocolon, transfixing it, and thus holding the knuckle in place, while the next step is performed. (Fig. 106.) This consists in

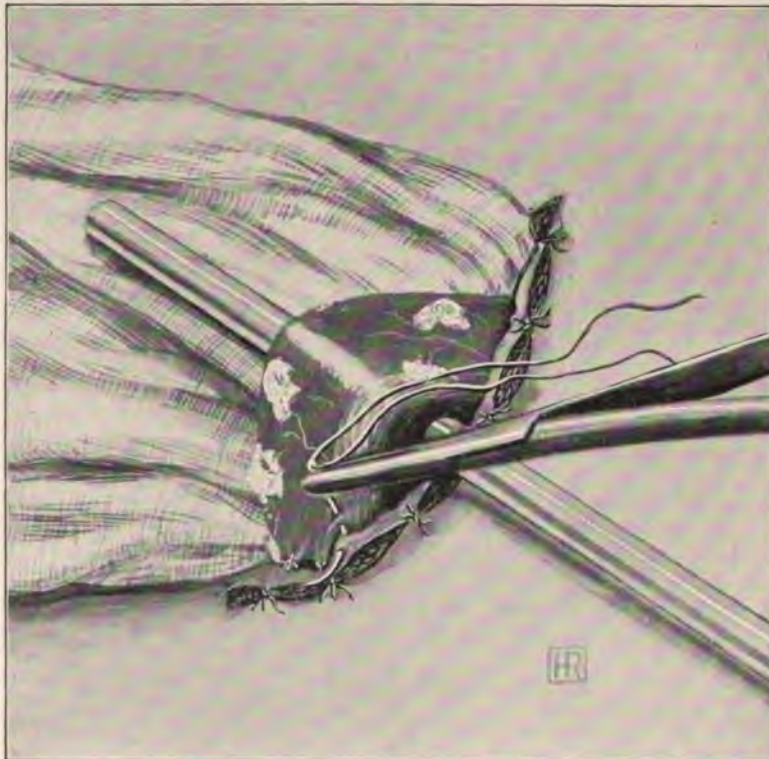


FIG. 107. — Suturing the loop of colon to the parietal peritoneum.

suturing with fine silk the entire circumference of both legs of the loop, and of the mesocolon to the peritoneum, which has been made fast to the skin of the abdomen, thus making the entire loop of large intestine extra-peritoneal. (Figs. 107, 108.) Having surrounded the protruding gut with a ring of gauze, so placed that not a particle of fecal matter may enter and soil the peritoneal cavity, the colon may be incised longitudinally, securing with forceps any bleeding

points in its wall. If the case is not extremely urgent, it is well to postpone this step of the operation until adhesions shall have formed between the parietal peritoneum and the peritoneal coating of the colon. So short a delay as six hours will suffice to make the opening of the gut distinctly safer than if it were done at once, while if from twenty-four to forty-eight hours are allowed to elapse between the steps of the operation, the danger of peritoneal infection will be almost *nil*. No anæsthetic need be employed for the second step of the operation, when it has been thus postponed, since the colon is insensitive to incision or cauterization, though colicky pain will be caused by rough, blunt manipulations or by distention.

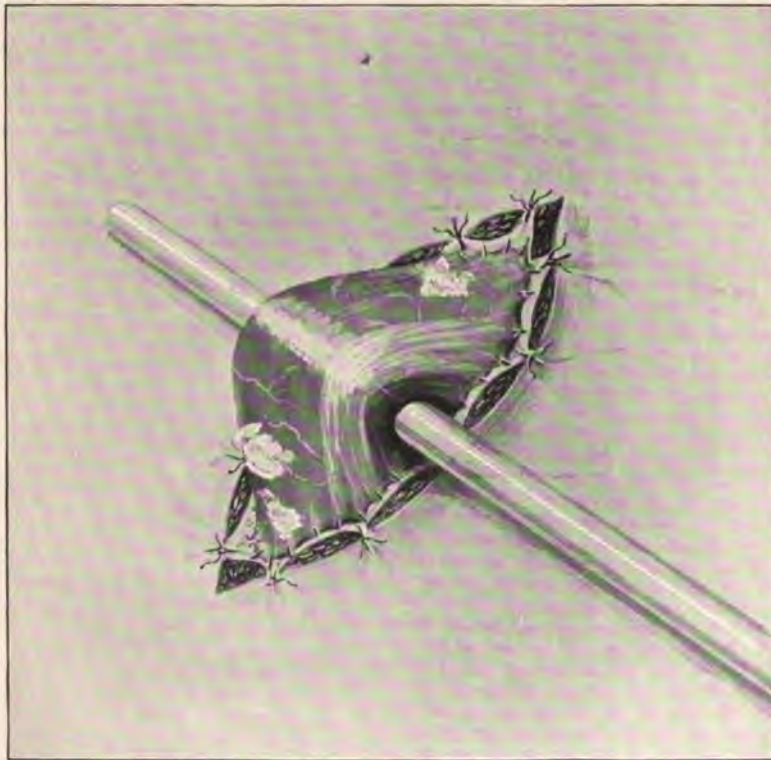


FIG. 108.—First stage of operation completed. Nothing remains but to open the intestine.

The colon having been opened there will be an escape of gas, and perhaps of liquid feces, which have been unable to pass the impaction, so that the patient will almost immediately experience relief. It will now be seen that the probe or rod, which was used to keep the gut raised out of the abdominal wound, has, together with the sutures, formed a septum or spur between the afferent and efferent portions of the intestine, so as quite effectually to prevent the entrance of feces into the efferent or distal portion. A woven catheter or a rather stiff rubber rectal tube should now be passed into the ascending colon as far as it will go, and with a hand syringe six or eight ounces of warm olive-oil should be injected and allowed to remain, the tube being withdrawn. The dressing may now be applied, no pressure being made directly upon the exposed loop, which should be protected by means of thick circular gauze pads, as described on page 188 in speaking of the dressing after the operation for empyema. Five or six hours after injecting the oil, the colon should be irrigated through the long tube by way of the wound, using large quantities of soap-suds. Fecal matter will probably escape alongside as well as through the tube, on removal of the irrigator tip. These irrigations should be very thorough, should wash out gut above and below the wound, and be repeated twice daily until the intestine is clear, and the fluid can be made to pass freely by the rectum. If this cannot be accomplished after, say, a week, it is probable that a neoplasm blocks the way, and that the advisability of further surgical procedures will have to be considered.

Tumors causing Symptoms of Acute Obstruction. — Occasionally an acute case may be encountered in which there is a distinct history of more or less chronic disturbance, such as constipation, the passing of blood or mucus by rectum, colicky pains, and rapid emaciation. If, now, a tumor can be made out by palpation, it will be worth while to incise over the mass, to explore it in order to learn its character, exact size, and anatomical connections, and then to act according to the patient's probable ability to withstand the shock of

a radical surgical procedure, such as the resection of the loop of bowel which bears the tumor. If the patient is old or feeble, and there is even a slight doubt as to his survival of the resection, the operator should by all means rest content with tiding over the emergency, reserving other procedures for some future time when the conditions shall be more favorable. Colostomy, performed approximately after the method just described, will then be the operation of choice. The opening into the bowel should not, however, be too near the tumor. If colostomy has to be performed through the left side, as much as possible of the descending colon should be drawn down, and the knuckle of gut drawn into the wound should be formed from the uppermost available part of the large intestine, so that subsequently prolapse may not occur. During the after-treatment, it is of importance that the distal as well as the proximal part of the bowel should be kept clean by means of enemata and irrigation.

CHAPTER XIII

ACUTE APPENDICITIS

Acute Appendicitis. — There are two causes which may produce this disease: infection within the appendix itself and infection by extension from inflamed neighboring organs, the former being by far the most frequent. Various conditions predispose the appendix to inflammation from within, such as the presence of irritating concretions or, more rarely, foreign bodies, traumatism producing contusions, twists or sharp bends causing strangulation, thrombosis of the vessels of the mesoappendix, and the presence of certain specific lesions, such as those of typhoid fever. Entozoa have in some instances been looked upon as the cause of irritation sufficient to light up an inflammation in this exceedingly susceptible organ. The appendix normally, by the peristaltic action of its muscles, gets rid of its secretions and of such fecal particles as may have entered its lumen. When, however, there is any internal irritation, its mucous and lymphoid elements become swollen, closing the lumen in part or completely, so that drainage is more or less interfered with, and decomposition of the retained secretions takes place, with the formation of still larger quantities of irritant material and consequent further intumescence. The muscular and peritoneal coats of the appendix being quite unyielding, rigidity and pain result. Still later, a condition of strangulation with consequent gangrene and perforation of the wall takes place. Usually adhesions have by this time formed between the inflamed appendix and the omentum or neighboring coils of intestine, so that when perforation occurs the septic fluid from the gangrenous organ is for the time

encapsulated, and may not infect the general peritoneal cavity. In other cases adhesions are slow to form or they do not form at all, and the infection at once becomes diffuse. Septicemia may set in at any stage of the disease, even when there has been no perforation and no visible gangrene. Suppuration having taken place, it may spread in any direction; but as a rule with numerous exceptions, the pus travels toward the outer side of the iliac region and toward the rectum. Metastases, especially where suppuration is between the layers of the mesocolon, are not uncommon, the liver being a favorite seat for secondary abscesses. The prognosis is always grave when there is suppuration in the mesentery or mesocolon, even when the other anatomical features of the case and the clinical symptoms are favorable.

The location of primary abscess will depend largely upon the site of the appendix before the attack. This is, normally, in the right iliac fossa, the base of the organ as it springs from the apex of the cæcum occupying a position between the anterior superior spine of the ilium and the umbilicus, and continuing behind the cæcum in the same plane, but in a slightly backward direction, for a variable distance. The average length of the appendix is about three inches, though it may be so short as to be a mere rudiment, or it may be very fleshy and seven or eight inches long. Its direction, too, varies to such an extent that there is hardly a place in the abdomen which the tip may not occupy. The meso-appendix is sometimes long and sometimes short. It usually contains but one principal artery, which, however, sends several branches into the organ. The appendix in some instances lies in a sac or cavity between the layers of the mesocolon. The entire organ may be found imbedded, as it were, in the cæcal wall, so that at first sight it appears to be absent altogether. In such cases it may, however, be felt through the wall of the intestine.

Without surgical intervention the attack may end in recovery, more or less permanent, in one of the following ways:—

There may be gradual abatement of the inflammation with the disappearance of all acute symptoms, the œdema of the lining of the appendix gradually giving place to a condition of hyperplasia with more or less regular or irregular narrowing of the lumen of the tube; a condition predisposing to other attacks of the disease.

There may be ulceration of the mucous membrane at the base or neck of the appendix, allowing the pouch eventually to empty itself into the bowel, this ulceration afterward cicatrizing. This, on account of stricture formation, will almost certainly be followed by other attacks, the severity of which cannot be foretold.

There may be destruction of the inner coats of the appendix, leading to an almost total obliteration of the lumen of the organ. There will then be no more attacks of the disease, though there may be considerable pain, which, by simulating true appendicitis, keeps the patient in a state of mental unrest and physical discomfort.

There may be adhesion of some part of the appendix itself to the cæcum, and, perforation taking place into the bowel at that point, the appendix may empty itself, becoming thus a "jug handle," permanently opening by two orifices into the cæcum. Here it is very unlikely that there will ever again be a dangerous attack of the disease, though the patient will experience more or less constant pain, and, with the tender point in the abdomen, will present the picture of chronic appendicitis, which, indeed, the case has now become.

There may be abscess formation, with spontaneous rupture into the rectum or at some point upon the abdomen, followed by recovery more or less complete, perhaps followed by fecal or intestinal fistula, or a fistula leading into the appendix, which has become completely detached from the cæcum. Or none of these complications may occur, the abscess simply discharging, and the appendix sloughing away with subsequent complete recovery.

Acute appendicitis may be further subdivided into the usual acute form and the fulminant variety.

points in its wall. If the case is not extremely urgent, it is well to postpone this step of the operation until adhesions shall have formed between the parietal peritoneum and the peritoneal coating of the colon. So short a delay as six hours will suffice to make the opening of the gut distinctly safer than if it were done at once, while if from twenty-four to forty-eight hours are allowed to elapse between the steps of the operation, the danger of peritoneal infection will be almost *nil*. No anæsthetic need be employed for the second step of the operation, when it has been thus postponed, since the colon is insensitive to incision or cauterization, though colicky pain will be caused by rough, blunt manipulations or by distention.

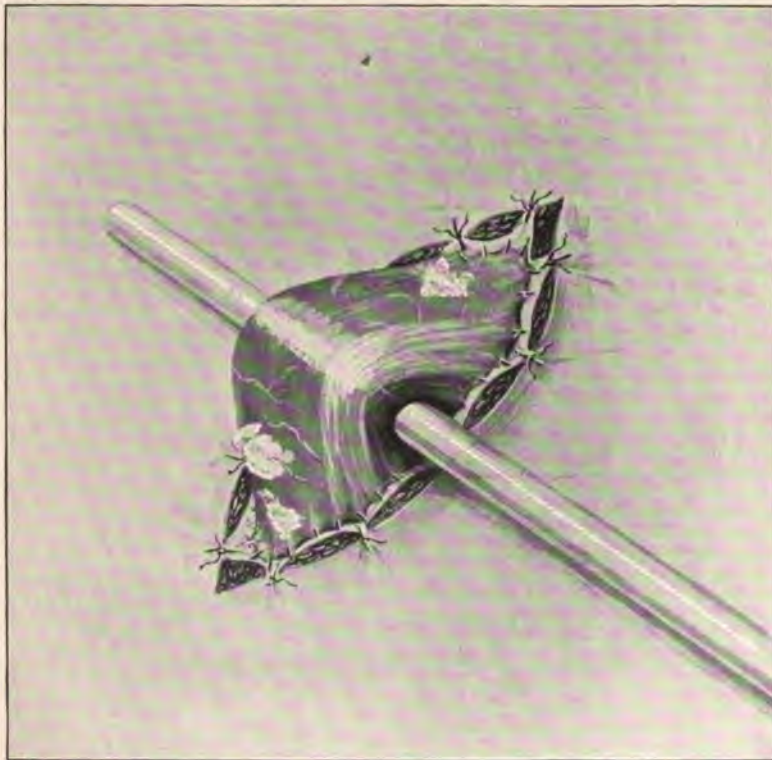


FIG. 108.—First stage of operation completed. Nothing remains but to open the intestine.

The colon having been opened there will be an escape of gas, and perhaps of liquid feces, which have been unable to pass the impaction, so that the patient will almost immediately experience relief. It will now be seen that the probe or rod, which was used to keep the gut raised out of the abdominal wound, has, together with the sutures, formed a septum or spur between the afferent and efferent portions of the intestine, so as quite effectually to prevent the entrance of feces into the efferent or distal portion. A woven catheter or a rather stiff rubber rectal tube should now be passed into the ascending colon as far as it will go, and with a hand syringe six or eight ounces of warm olive-oil should be injected and allowed to remain, the tube being withdrawn. The dressing may now be applied, no pressure being made directly upon the exposed loop, which should be protected by means of thick circular gauze pads, as described on page 188 in speaking of the dressing after the operation for empyema. Five or six hours after injecting the oil, the colon should be irrigated through the long tube by way of the wound, using large quantities of soap-suds. Fecal matter will probably escape alongside as well as through the tube, on removal of the irrigator tip. These irrigations should be very thorough, should wash out gut above and below the wound, and be repeated twice daily until the intestine is clear, and the fluid can be made to pass freely by the rectum. If this cannot be accomplished after, say, a week, it is probable that a neoplasm blocks the way, and that the advisability of further surgical procedures will have to be considered.

Tumors causing Symptoms of Acute Obstruction. — Occasionally an acute case may be encountered in which there is a distinct history of more or less chronic disturbance, such as constipation, the passing of blood or mucus by rectum, colicky pains, and rapid emaciation. If, now, a tumor can be made out by palpation, it will be worth while to incise over the mass, to explore it in order to learn its character, exact size, and anatomical connections, and then to act according to the patient's probable ability to withstand the shock of

a radical surgical procedure, such as the resection of the loop of bowel which bears the tumor. If the patient is old or feeble, and there is even a slight doubt as to his survival of the resection, the operator should by all means rest content with tiding over the emergency, reserving other procedures for some future time when the conditions shall be more favorable. Colostomy, performed approximately after the method just described, will then be the operation of choice. The opening into the bowel should not, however, be too near the tumor. If colostomy has to be performed through the left side, as much as possible of the descending colon should be drawn down, and the knuckle of gut drawn into the wound should be formed from the uppermost available part of the large intestine, so that subsequently prolapse may not occur. During the after-treatment, it is of importance that the distal as well as the proximal part of the bowel should be kept clean by means of enemata and irrigation.

Masses which feel larger than the finger are probably composed of adhesions of plastic lymph with or without the presence of actual abscesses; while frequently the thickened omentum wrapped round the appendix by these adhesions forms a considerable portion of the tumor. There are some abscesses which are not adherent



FIG. 109. — Method of palpating the right iliac region.

to any portion of the abdominal wall, but, surrounded by omentum and coils of intestine, lie otherwise free within the peritoneal cavity. Careful palpation may demonstrate this condition by the mobility of the tumor. The thickened, inflamed, and sensitive ureter may simulate appendicitis. The urinary symptoms, however, are likely to be such as to make differentiation possible. The iliac vessels, too, should not be mistaken for morbid structures.

In all acute cases, manipulations about the abdomen should be made with the utmost caution, for fear of rupturing the appendix or the walls of any collection of pus which may be present. When the symptoms are well marked, little is to be gained by actually feeling the tumor, distinct local resistance to pressure being, with other symptoms, sufficient evidence of the character of the disease.

The examination by rectum should never be omitted, no matter how clear the diagnosis may seem without this aid. A general tense bulging of the abdominal contents with no localized tenderness may simply indicate tympanites. A local bulging, tender on pressure, may mean abscess, while this sign, together with œdema of the rectal mucous membrane, would seem to indicate that the abscess was pointing in the rectum, and could be safely opened and drained at that point, thus relieving the acute symptoms and allowing partial or complete recovery from the attack, with a view to subsequent radical operation. If no objective sign is made out, but an increased tenderness toward the right side is noted, the observation may be of importance in connection with other symptoms pointing toward appendicitis.

To sum up, it may be said that the pulse and the temperature are of comparatively little value in diagnosing acute appendicitis, and that the pain, especially when localized, the vomiting, the abdominal rigidity, frequently most marked in the right side, the constipation, and last, but very important, the facial expression, form a clinical picture which is, in the great majority of cases, not difficult to recognize. The advance of the disease is characterized by more pronounced symptoms of general sepsis (see Chapter V.), and, often enough, by the occurrence of diffuse peritonitis. (Chapter XVI.)

Fulminant Appendicitis. — This terrible form of the malady is, fortunately, not common. It is to be recognized by the extreme violence of the onset and the frightful rapidity with which the symptoms progress. It sometimes happens that within six hours there is a distinct purulent peritonitis, and that within twenty-four

hours the patient has become profoundly septic. In children a convulsion may be the first alarming occurrence.

Treatment of the Acute Forms of Appendicitis. — When called to see a patient who is suffering from any acute abdominal disease, every available method of examination should be employed, even when the diagnosis seems tolerably clear. If the existence of appendicitis is suspected, the administration of opium in any form should be shunned, and chloroform, given by mouth or even by inhalation, should be preferred; the drug being employed with the object of lessening the appendicular spasm which is causing the colicky pain. When chloroform is administered internally, the dose should be from thirty to forty minims, repeated if necessary at intervals of half an hour, for three or four doses. The patient should be warned that the medicine is very pungent, and may cause momentary strangling and burning sensations. If administered by inhalation, the greatest caution should be observed, and no more chloroform used than just enough to give relief, full narcosis being carefully avoided. When localized pain and tenderness can be demonstrated, an ice bag should be applied, in order to retard the process if possible; but it must not be forgotten that the cold will act as an anæsthetic, so the absence of tenderness at a subsequent examination should not mislead one. In order to avoid error, it is sometimes advisable to remove the bag for half an hour before again making the examination. There is usually a remission of pain following this treatment, but it will recur in a few hours with greater or less severity, when, before giving further advice of any kind, the patient should be once more examined. If the symptoms progress at a very rapid rate, operative interference should not be delayed. The worst thing the surgeon can do is to wait a prescribed number of days or hours before deciding upon the course to be pursued. The progress of the disease should be the only guide, and, except during the first shock of the attack, operation is better performed early than late. As a very general rule, it may be said that when a patient has been sick twenty-four hours and seems worse at the end of that

time than at the beginning, it is probable not only that an operation is advisable, but that every hour of delay will subject our charge to additional danger. To be sure, the vast majority of cases may not be seriously prejudiced by a further delay, and, in some instances, genuine improvement may appear at the end of forty-eight hours or even later, the case ending favorably without operation. When this hoped-for result is not obtained, however, the patient cannot fail to be in worse condition for the ordeal of the operation, because of the time which has been wasted. It is not always an easy matter to determine just when palliation should give way to radical measures. It may be said, however, that early delirium or other disturbance of the sensorium, the occurrence of persistent vomiting, and the fact that the patient does not pass flatus, are symptoms which show clearly the necessity for haste. If, in addition, the pulse becomes rapid and small, or chills occur, the case may be regarded as exceedingly grave. When this entire group of symptoms is present, it does not matter whether the patient has been sick for twenty-four hours or four hours, the only treatment which holds out a reasonable hope of saving life is immediate operation. Palliation, except during the time necessary to make preparations, is then nothing short of culpable. A sudden remission of symptoms, both objective and subjective, occurring spontaneously after the first six or eight hours following the beginning of the attack, may be looked upon as a danger-signal; for it often enough means that gangrene or perhaps perforation has occurred, the tension in consequence being relieved. When the diagnosis was clear before the remission, the decision to operate should by no means be changed. If there was reasonable doubt, however, the patient should be constantly watched, so that action may not be delayed beyond the first recurring signs of danger.

Operation. — Having decided to operate, preparations should be made in the manner described in Chapter XI. At least two assistants will be required in addition to the anæsthetist, and as these two may be needed at the wound, a nurse or two will not be found

superfluous. General anæsthesia will invariably be required. Before administering the ether or chloroform, it is of importance, where there has been much vomiting of offensive matter, to wash out the stomach as a preliminary step, to prevent, if possible, the entrance

of septic material into the trachea and bronchi during vomiting in unconsciousness.

While in chronic or sub-acute cases it may be allowable to make what may be called the incision of election, in the acute cases the point of attack must depend upon the location of the tumor, the most resistant portion of the abdominal wall, or even the spot of greatest pain and tenderness, as indicated by the



FIG. 110. — The operation for appendicitis. Skin, aponeurosis, and anterior sheath of the rectus retracted, showing the outer edge of the muscle.

patient before he was anæsthetized. The incision of choice, when there is no tumor and the exact location of the diseased organ is not known, should be parallel with the right semilunar line, and just within the border of the rectus muscle, the incision taking in the skin and the fasciæ down to the muscle itself. To begin with, this incision should be about two and a half inches in length, the

line between the umbilicus and the anterior superior iliac spine crossing its upper third. If it is later found necessary, this incision may be considerably extended. Only in the chronic or relapsing forms of the disease, when the operation is performed in the so-called "interval," are the very short incisions safe.

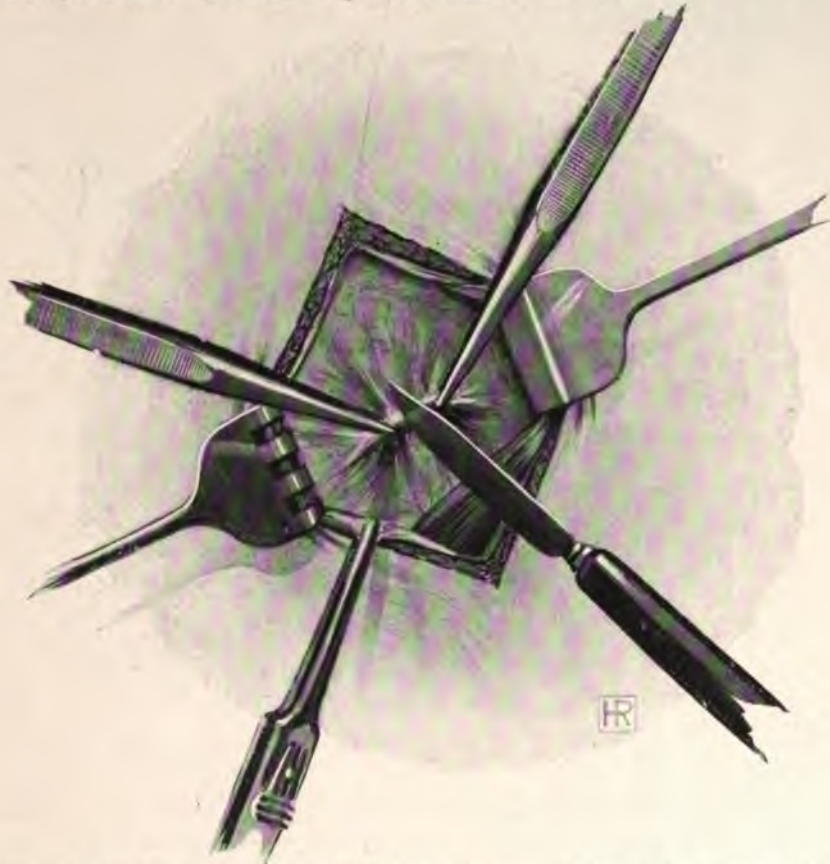


FIG. 111.—Rectus muscle drawn aside with blunt retractor. Incision of the posterior sheath of the rectus and the peritoneum between mouse-tooth-forceps.

Having exposed the belly of the rectus (Fig. 110), a blunt retractor, held by an assistant, should be inserted beneath its edge, and the muscle should be strongly drawn toward the median line. (Fig. 111.) The remaining dissection should be through the

tissues exposed by the retraction of the rectus, so that when the operation is finished the muscle, assuming its normal position, shall cover the incision through the tissues behind it, thus reducing the probability of subsequent hernia. The dissection through the posterior rectus sheath and the peritoneum should be carefully per-

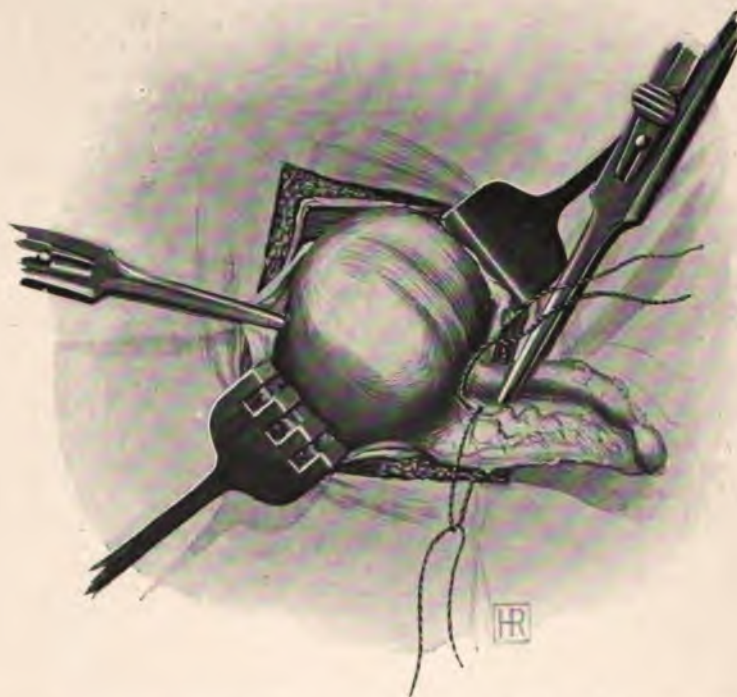


FIG. 112. —Cæcum and appendix brought out of the wound. Note relation of the base of the appendix to the longitudinal striation, and also pathological constriction near its tip. The ligatures have not yet been tightened.

formed by incising between two mousetooth-forceps, which should raise the tissues away from the viscera, in order that intestine or omentum may not be accidentally wounded. (Fig. 111.) In order to render unlooked-for traumatism still less liable, the mousetooth-forceps should take very small "bites," and the instrument held by

the assistant should invariably follow closely that manipulated by the operator. Both forceps should never relax their hold at the same time, but may be alternately shifted in the line of the wound as the scalpel nicks its way along between them. The accidental opening of intestine which, lying close to the parietal peritoneum,

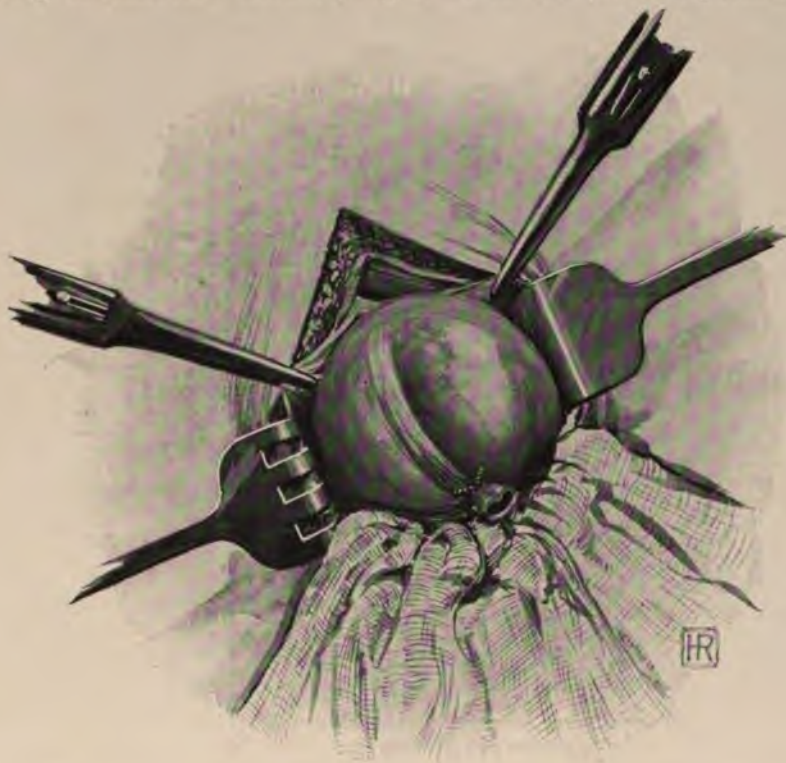


FIG. 113. — Stump of appendix, showing how the ligature has cut the mucous membrane and the muscular coat. It evidently cannot slip off. The gauze will now be withdrawn and the intestine replaced.

gets into the grasp of the forceps, should be most carefully guarded against. Before incising the peritoneum, all hemorrhage should be checked by artery-forceps. The little bleeding points in the skin will probably not require ligation, since they are usually stopped permanently by the pressure of the forceps. A vessel or

two running across the line of the incision may require ligature, but the most important group which is likely to be encountered is made up of the deep epigastrics, which lie in the plane between the peritoneum and the fasciæ, forming the posterior sheath of the rectus. They cross the line of incision obliquely and continue upward along the rectus, half an inch or more from its edge. The exact location and direction of these vessels is somewhat variable, so that they may not be seen at all in an incision of two and a half



FIG. 114.—Closing the peritoneal wound with running catgut suture. A piece of gauze protects the viscera from puncture.

able time and considerable blood may be lost. The left index finger, pulp upward, may be inserted into the wound at its lower angle, when the artery will be easily felt pulsating against the tense, uncut portion of the abdominal wall. With the scalpel, the fascia may now be divided while the finger remains beneath the artery, until the accompanying veins come into view, when the vessels may be easily ligated after clamping them and dividing them between two forceps. (Fig. 115.) During the procedure of exposing the epi-

inches, though they are very commonly encountered when it becomes necessary to extend the opening downward. The enlarging of the wound with scissors or with the blunt bistoury, a method never to be recommended, is here particularly to be eschewed, since the epigastrics, when once blindly injured, retract and are sometimes far from easy to secure; thus valu-

gastric vessels, the finger should not keep up a steady pressure against the abdominal wall, but should occasionally intermit as the dissection approaches the vessels. If this precaution is not taken, the veins, being emptied by the pressure, and therefore decolorized, may be incised before they are seen. The nerves which run to the rectus muscle obliquely downward from the spine should be drawn aside with retractors, if possible, so that they may not be cut.

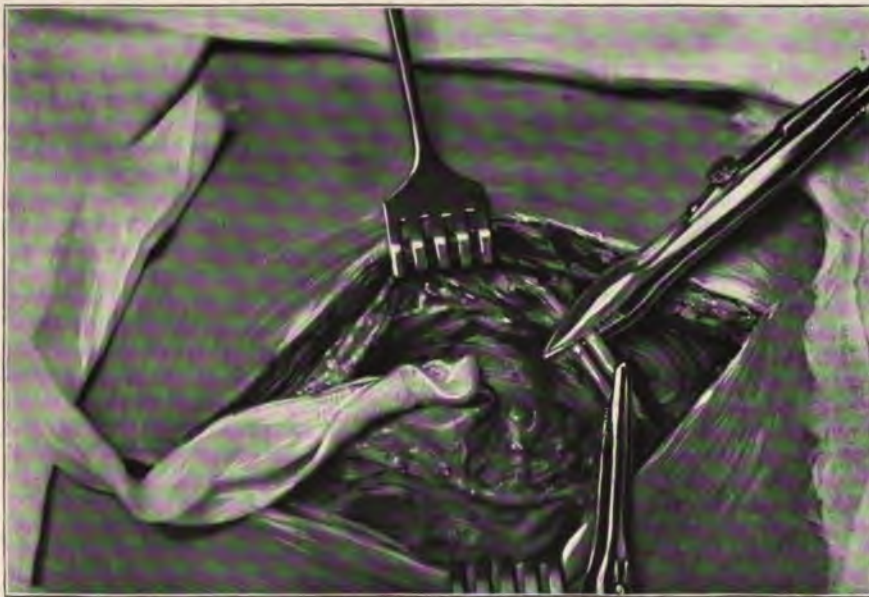


FIG. 115.—Operation for appendicitis. In this instance the incision had to be prolonged, and the epigastric vessels are seen, clamped before division. A piece of gauze plugs a premature opening in the peritoneum.

At the first nick made in the peritoneum, the presence or absence of free fluid must be noted. Serous or seropurulent exudation or pus, with or without odor, may be present. Free fluid of any variety is, in acute appendicitis, always an unfavorable sign, and is usually an indication of the diffuse character of the accompanying peritonitis. The wound should be enlarged without further delay. If no fluid escapes, the finger of the operator may cautiously

explore the abdomen through the incision, the greatest gentleness being observed lest tender adhesions be ruptured and the abdomen flooded with pus or other infective material from a hitherto unsuspected abscess. Any abnormal resistance encountered by the exploring finger should be regarded with suspicion, and the wound further enlarged, provided the doubtful mass cannot be



FIG. 116.—Appendix held up by an assistant. Note, again, continuation of the base with the striation of the cæcum.

properly reached through the opening already made. No matter how simple it may seem to isolate an appendix from a mass of adhesions, even when the size, shape, and consistency of the tumor render the probability of abscess remote, no attempt at such isolation should at this time be made. Even if malodorous pus is encountered immediately on opening the abdomen, it must be understood that other and more virulent material may be imprisoned within the mass of adhesions, and that this is by no means to be liberated until every precaution has been taken to protect the remaining portions of the peritoneal cavity from infection.

With blunt retractors so placed that neither intestine nor omentum may be accidentally caught between the instruments and the parietes, the abdominal wall may be lifted away from the viscera for their inspection. The appearances will not be identical

in any two cases, but certain types exist which will here be described.

In early acute appendicitis without gangrene or perforation, injection of the vessels of the intestines in the iliac fossa may be noted. Tender adhesions may bind several coils together, or a protecting covering of omentum may have wrapped itself around the diseased region to which it has become lightly adherent. Or, perhaps, there is nothing but the slight injection already spoken of to indicate the presence of a dangerous pathological condition, and even this sign may not be visible on first opening the abdomen, the contents of the peritoneum presenting quite a normal appearance. In the absence of adhesions, the next step will be to find the ascending colon and cæcum as landmarks in the search for the appendix. An appendix or even a small mass of adhesions, easily felt against the pelvic wall by palpation through the unopened abdomen, may be difficult to detect by the sense of touch through the open wound. In differentiating between large and small intestine, it should be remembered that normal small intestine is smoothly cylindrical or cylindroid in shape, and of a uniform color; while large intestine is bluish gray in hue and is marked by two or three fibrous, white, retracted, longitudinal striations where the wall is denser than that of other portions of the intestine. Fatty epiploical appendages hanging from the walls of the colon and cæcum make this portion of the intestine still more striking in appearance. The cæcum and ascending colon lie along the outer side of the abdomen, against the pelvic wall and loin. Occasionally an abnormally long sigmoid flexure of the descending colon lies in the right side of the abdomen, and may be mistaken for the cæcum. Unless it is recognized at once, considerable time may be lost in looking for the appendix, so the possibility of the abnormality should always be borne in mind. The sigmoid is not usually so large in circumference as the cæcum, and while it possesses the longitudinal striations, the epiploical appendages are fewer and smaller than those of the cæcum. If in spite of

these observations there is still difficulty in recognizing the structure, the intestine should be passed rapidly between the fingers, when the length of the coil and the absence of the cæcal extremity



FIG. 117. — Turgid, highly inflamed appendix which has been turned out of a bed of adhesions. It is gangrenous in spots and almost perforating. Gauze packings protect the peritoneal cavity. The mesoappendix is tied in two sections. The conical shape of this appendix is due to old obliterative changes toward the tip.

will naturally cause suspicion that we are dealing with the sigmoid, and search should be immediately made behind and beneath it for the ascending colon and cæcum. Having now found the ascending colon, a "knuckle" should be drawn toward the wound and passed upward between the fingers until the cæcum is found. The base

of the appendix is usually in a line continuous with that longitudinal striation which is opposite the mesocolon. (Figs. 112 and 116.) If there is the least resistance to traction upon the cæcum, adhesions about the appendix must be suspected, and, before proceeding further, the surrounding peritoneum must be carefully protected from possible contamination by gauze strips from two to four inches in width, so placed that the intestines and other structures adjacent to the wound may not be soiled by toxic material which may escape on manipulating the appendix and its surrounding adhesions. (Figs. 117 and 118.) The finger may now be carried along the longitudinal striation and onward in the same direction, when the appendix will probably be felt as a turgid and elastic body. During this procedure, much depends on the proper retraction of the edges of the wound by the assistants exposing the deeper structures which we are manipulating. The tip of the organ should be felt for, and having been found, it should, if possible, be gently drawn out of the wound or even turned out of its bed of adhesions and exposed to view. It will probably be intensely injected and, perhaps, partly covered with a pale, greenish deposit of lymph which should not be mistaken for pus or gangrenous tissue. The lymph may be peeled off,



FIG. 118.—Specimen of appendix which was removed with adherent omentum and unruptured abscess. The abscess wall has now been incised, showing the cavity which contained the pus, a perforation near the tip of the appendix, and a concretion which has evidently escaped through the perforation. The upper portion of the omentum is healthy. The base of the appendix is below, but its lumen is turned away and is not seen.

showing the red, inflamed, and possibly bleeding serous covering. Rarely the appendix occupies a sort of pocket in the wall of the cæcum, being invisible, and discoverable only by palpation. Such an appendix may be the seat of dangerous disease, and must be reached by an incision through the serous coat of the cæcum. The pocket occupied by the appendix will be found lined with peritoneum, and the appendix is covered, just as is any other appendix, with a visceral serous coat. Occasionally it happens that the omentum has wrapped itself round an inflamed, perhaps a perforated appendix, in such a manner that the entire mass, appendix, omental adhesions, and all, can be easily drawn up into the wound. The omentum should in these cases be ligated in sections, and removed, together with the appendix, and without having disturbed the adhesions. (Fig. 118.)

While the chief assistant holds the organ upward so as to expose the mesoappendix (Fig. 116), this membrane should be ligated with fine transfixing catgut strands passed through it with the aid of a small aneurism needle or with an ordinary thumb-forceps, the ligatures being placed far enough from the appendix to insure against the danger of slipping when the mesoappendix is cut away. (Figs. 112 and 117.) After tying off the mesoappendix, a catgut ligature, strong but fine, should be passed around the base of the appendix itself and very slowly but firmly tightened. The mucous and muscular layers are cut by this ligature, but the submucous fibrous tissue and the peritoneum are left intact, forming a stout point of closure. The appendix may now be clamped with an artery-forceps about half an inch from the point of ligation (Fig. 112), and after protecting the surrounding tissues with a folded piece of gauze slit so as to closely encircle the infected organ at its base, it may be ablated with scissors. The lining membrane of the proximal portion or stump should be cleansed by wiping with a piece of sponge held in a forceps, and should then be disinfected with a very minute bit of sponge soaked with pure carbolic acid. No carbolic should be allowed to come in contact with

any other tissue than that which it is desired to cauterize, for fear of accidentally causing necrosis which might later lead to intestinal perforation or some other complication. After a few moments the action of the carbolic is complete, and then there is no danger that other tissues coming in contact with the stump may be cauterized. This simple way of treating the stump of the appendix is absolutely safe in the cases where it is possible by any method to close the intestinal lumen.



FIG. 119.—Appendix ligated and ready for ablation. The ligature is left long and held so the stump may not slip away before it is disinfected. This appendix cannot be drawn further out of the wound because of adhesions and a short mesocecum.

It should not be forgotten that the scissors which were used for the purpose of dividing the appendix are now surgically unclean, and must be disinfected before they may again be used. The gauze packings, which were put in to protect the viscera from infection, may now be withdrawn, and the wound of the peritoneum closed with a running suture of fine catgut. (Fig. 114.) This step of the

operation may be greatly facilitated by having the skin, muscles, and fasciæ held apart by sharp retractors, which thus take in all the tissues except the peritoneum. This membrane should be sought out and the angle of the opening held in view by the chief assistant with a mousetooth-forceps. The work of suturing the peritoneum should be performed in a painstaking manner, and with a constant eye to the danger of transfixing the viscera with the needle and including them in the suture. An assistant should always hold the thread taut as it emerges from each suture-opening, and by this thread the peritoneum should be raised away from the abdominal contents as the new stitch is passed. If the omentum or the intestines tend to protrude from the wound to the embarrassment of the operator, a narrow, folded piece of gauze may be tucked away along the wound, and within the peritoneum, which will hold the viscera in place (Fig. 114) until the peritoneal closure is almost complete, when it should be gradually removed, the last suture or two being passed with especial care. The wound should now be for a moment filled with sublimate solution, one to one thousand, which should then in turn be washed away with saline solution, and then the suture of the remaining layers of the abdominal wall may be begun. For this purpose, chromicized catgut of small size may be used, placing about four interrupted sutures to the inch. The posterior sheath of the rectus, the anterior sheath, and the aponeurosis should be closed in this manner, but the skin need not be sutured, or, if the wound is quite a large one, a few fine silk stitches, say one to the inch, may be very superficially placed, so that there shall not be too much gaping. A dry absorbent sterile dressing of gauze should be held in place with adhesive strips, and over this dressing comes a pad of absorbent cotton and a binder or bandage.

When, after walling off the abdominal cavity, as described above, the peeling loose of adhesions is followed by a gush of pus, this must be wiped away with the greatest care, using sponges on holders, or bits of sponge held in forceps, according to the size

and accessibility of the cavity. If the digital separation of adhesions is performed with care and not too rapidly, the flooding of the wound can, in many instances, be avoided; for as soon as the abscess cavity is invaded through a minute orifice, the fact is made evident by a bead of pus, which appears at the opening. This droplet having been wiped away, another appears, and is in its turn removed, the process being repeated until the abscess cavity is empty. Each little sponge or gauze pledget must be thrown away as soon as it has been used. Then the remaining adhesions may be broken down, and the cavity exposed and cleansed as well as possible by wiping it with gauze or sponges either dry or wet in antiseptic fluids, such, for example, as two per cent. carbolic solution, or, still better, the stimulating peroxide of hydrogen in fifteen volume solution. The cavity should now be wiped out with normal salt solution, and then the adhesions forming its wall may be separated, if necessary, in order to find the appendix. This may form a part of the abscess wall itself, or it may occupy a little nest-like cavity of its own, connected directly with the one first opened. All pus cavities should be temporarily plugged with gauze, while the appendix is removed according to the principles laid down above. There will probably be more or less gangrene, and also perforation, so great watchfulness should be practised in order to avoid spreading the infection. All instruments which have directly or indirectly come in contact with the appendix should be resterilized at once, or not used again during the operation.

It sometimes happens that an appendix is so situated that it cannot be drawn out of the wound or even near the surface without the danger of rupturing blood-vessels or injuring other tissues or organs. A short mesocolon or mesoappendix with adhesions of a dense character are to blame for this. (Fig. 119.) It may even be necessary to enucleate the appendix from its peritoneal coat, after having tied its neck or base in the usual fashion. Sometimes even this cannot be done, but the appendix must be cut in two,

and each portion taken out separately. When it is actually impossible to remove the appendix by any method, its presence may be rendered innocuous by scraping away the entire mucous and lymphoid tissue, and packing the remaining cavity with gauze. However the appendix is treated, it is necessary that no gangrenous tissue be left behind. Where there has been extensive necrosis of the appendix, the cæcum itself must be inspected for points of gangrene, which should be excised, and the resulting openings closed by suture. Infected gangrenous or thrombosed omentum should be ablated after carefully ligating it through healthy tissue with fine catgut ligatures, numerous enough to avoid the fault of encircling too great a mass at once.

It may happen that a friable appendix, perforated at its base, comes away on slight traction, and that it is not possible, without great violence to the tissues, to raise the cæcum to an accessible point. If the cæcal opening can be seen, a gauze packing laid firmly against it will be very likely to prevent infection through the leaking of fecal matter from the bowel, though subsequent fecal fistula is extremely probable. The majority of fistulæ in this region close spontaneously.

Where there has been much suppuration in the abdomen, it is unsafe to consider the operation complete without passing a sponge on a holder down into the pelvis, in order to ascertain whether there may not be a collection of septic material here also. If this is found to be the case, sponge after sponge must be passed down until no more fluid can be removed. A gauze wick wrapped in gutta-percha tissue and fully the thickness of a cigar should be pushed into the pelvis with a dressing-forceps, and left there, the end protruding from the abdominal wound. All other packings should now be removed, and those which were in abscess cavities renewed, while the protecting packings are left out. Cavities which are far from the surface may be drained with gauze and gutta-percha tissue, the size of a cigarette, in order to avoid the dragging upon intermediate structures when the wick is removed; for

the gauze will become firmly adherent, while the gutta-percha tissue will not, although a track walled off by viscera adherent to each other will be formed around it. A single gauze pad of about four thicknesses, cut a little larger than the wound itself, should now be laid over the viscera, its edges projecting a little beneath the peritoneum, so as to act as a dam against protrusion when the patient strains. The wound should be packed with loose gauze, and covered with a pad held in place by adhesive straps. Over this, more absorbent gauze or cotton should be placed, and held by a binder or bandage.

Where diffuse inflammation of the peritoneum exists, with appendicitis as the exciting cause, the appendicitis should be treated according to the principles and methods just described; but in addition, the peritonitis itself will require a certain line of treatment, both operative and otherwise, which will be discussed in Chapter XVI.

When on examination before section it seems probable that an abscess exists in close proximity to the abdominal wall and possibly adherent to it, an effort should be made to enter and drain it without exposing the peritoneum to the danger of direct infection. Careful palpation and percussion should be practised, and the incision should be made at such a point as seems to be most accessible and most favorable to drainage. The class of abscesses which may oftenest be treated in this way are those which are located far to the outer side of the abdomen, near the groin or along the crest of the ilium, and extending into the loin. The incision, of such length as seems to be necessary, may safely follow along the line of the iliac crest, and thence along Poupart's ligament. These abscesses should be drained by tube, and when the collection of pus is large no attempt should be made to find and remove the appendix, unless that organ happens to be easily accessible. When the abscess is small, the search for the appendix is more promising and may be cautiously attempted.

Post-Operative Treatment. — For the first twenty-four hours the patient should be kept perfectly quiet. The administration of liquid

nourishment in doses of a drachm at a time may be permitted after the first twelve hours, provided there is no vomiting and no nausea; but where the slightest tendency to vomiting exists, it is best to forbid all nourishment by mouth. Milk and lime-water in equal parts, a drachm at a time, every five to fifteen minutes, is usually retained without difficulty. As the nausea disappears, the quantities may be increased.

During the first few hours after the operation the pain of the wound may be considerable, requiring small doses of morphine hypodermically administered. When this initial pain has subsided no more morphine should be given, though other pain caused by the distention which frequently follows abdominal section may supervene. Codeine in full doses, say two or even three grains, will then be decidedly preferable, since the disagreeable after-effect of this drug upon the bowels and in fact the entire alimentary tract is far less than that of morphine.

Vomiting and retching are sometimes annoying and rebellious. When accompanied by violent straining actual harm may be done, such as the tearing out of the sutures with prolapse of the viscera, the loosening of ligatures with recurrent hemorrhage, or the separation of adhesions with spreading of infection through the abdomen. Hot water or hot peppermint-water, in doses of a drachm each, every five or ten minutes, will often act as a gastric sedative, while some persons bear little pieces of ice better. As a rule, however, hot fluids will be found more serviceable than cold, while ice seems in many instances to cause thirst instead of quenching it, even when it acts well in quieting the tendency to vomit. If there is considerable vomiting of gastric, biliary, and duodenal fluids, lavage of the stomach will give great relief, bringing up not only the irritating secretions but the accumulated gas as well. It is a good plan to pour three or four ounces of warm water with a drachm of the subnitrate of bismuth in suspension into the funnel when the washing is finished. This treatment will often succeed when all else has been vainly tried.

The lavage may be repeated in a few hours, should the unwelcome symptoms recur.

After the first twenty-four hours the bowels should be moved with the help of calomel. This drug may be given in half-grain powders every fifteen minutes, until two grains have been taken. If vomiting seems to be excited, it is well to encourage normal peristalsis by enemata, first of soap-suds and later, if necessary, by the high injection of a pint of warm peppermint-water. Continued vomiting without the escape of flatus in spite of these enemata is an evil symptom often giving the first indication of visceral strangulation or septic peritonitis. The wound should then be dressed, and the packings carefully examined, removing them, if necessary, to see whether a knuckle of intestine may have become in some way constricted. If the calomel is retained, it may be confidently expected that a movement of the bowels will follow, even if the action is deferred as long as ten or twelve hours. When greater promptness is desired, the calomel may be followed by a series of small doses of some saline purge, the first dose to be given an hour after the last dose of calomel.

The urine, after the operation for acute appendicitis, as, indeed, after any operation for a septic disease, should be frequently examined both chemically and by the microscope. The quantity, too, should be measured and noted, and a specimen from each urination saved and numbered so that comparison may be made and an intelligent observation of the progress of the case be kept. The urine is, at first, nearly always concentrated and high-colored. It often contains a trace of albumin, at first without casts and later with renal elements, if the case is progressing favorably and artificial diuresis washes out the tubules of the kidneys. Scanty, even slightly albuminous, urine with bile-pigment and without casts is one of the indications of sepsis, and is particularly common where the peritoneum is the absorbing surface. Digitalis or strophanthus, combined with calomel or bichloride of mercury, in small doses, will be found to act well. If the patient is not nauseated, the pill

containing a grain of powdered digitalis, a grain of powdered squills, and the thirty-second of a grain of the bichloride of mercury, may be given every four hours with good effect. Copious draughts of *hot* water will also aid diuresis. Urotropine in five-grain doses, repeated every four hours, is an efficient diuretic as well as a urinary antiseptic of value. As a last resort, when anuria threatens, the intra-venous saline infusion may be looked upon as probably the most powerful diuretic agent at our disposal. (Chapter IV.)

The Pulse. — If the pulse is steady, even though rapid, stimulation should be avoided so that symptoms may not be masked. Irregularity or great rapidity with weakness should, of course, be the signal for free stimulation by a few powerful drugs, avoiding the coincident exhibition of many different cardiac stimulants. Strychnine hypodermically in doses of the fortieth of a grain repeated every fifteen minutes until it has been administered four times will usually whip up the flagging heart. Muscular twitching is the signal that the physiological limit of the drug has been reached. Good whiskey or brandy may be given by the hypodermic method until from two to four ounces have been injected. A single small dose of morphine, say the tenth of a grain, will also be found to be a reliable stimulant. Here, again, the use of the intra-venous infusion should not be forgotten in time of need. In short, all the methods of resuscitation mentioned under the heading of shock and collapse in Chapter IV. are in order when the vital forces fail after the operation for acute appendicitis.

The Temperature. — The temperature, whether it was high or but slightly elevated before the operation, nearly always reaches 100° to 101° F. on the following day, and a rise even to 102° F. should not, in the absence of other unfavorable signs, be regarded as of evil portent. It may, indeed, be in some instances a good sign, as, for example, when the patient's condition was distinctly septic with a low temperature before operation. Here a continued normal or subnormal registering of the thermometer may indicate continued sepsis or shock.

Change of Dressings.— At the termination of the first forty-eight hours after the operation, it is to be expected that, in a favorable case, there will be a distinct improvement in the patient's condition. The wound should now be dressed unless the abdominal cavity was completely closed by suture, when, in the absence of unfavorable symptoms, there need be no inspection until the fifth or sixth day. The oozing of serum, or other wound-secretion, may have necessitated the changing of the superficial gauze several times during the two days following the operation, but at the first inspection of the wound the cigarette drains should be removed and replaced by very thin strands of gauze carefully carried down to the end of the pocket which was occupied by the wick. The gauze packings next to the viscera should not be disturbed without reason for four or five days, when there will be less danger of dragging upon the adherent intestine or omentum and perhaps again opening the general peritoneal cavity. If, however, we are dealing with an abscess which has been packed, the gauze may be removed on the second to the fourth day, according to the amount of discharge and the probability of retention. When packings have been removed or changed, and it is not certain that firm adhesions wall off the free abdominal cavity, perfect quiet should be enjoined for the following twelve hours, in order to make sure that no untoward movement on the part of the patient may cause the spreading of infection. A wet dressing should be the one of choice after the first twenty-four hours, and over the waterproof covering there should be a dry elastic pad of gauze or cotton held in place by a firm binder, or spica bandage. Adhesive strips next to the waterproof material will act as a further support, preventing prolapse of the viscera. Dressings should now be changed daily, and when granulation has set in a few sutures of chromicized catgut may be used to draw the fasciæ and peritoneum over the viscera, thereby reducing the probability of subsequent hernia. The skin, of course, should not at this time be sutured, though it may be drawn together with adhesive plaster. No anæsthetic is required

for this little procedure, since it is accompanied by scarcely any pain. Even if there is mild suppuration where the sutures were put in, the approximation is apt to remain good, and convalescence is materially shortened. As soon as the wound is clean and seems to be healing, dry dressings will be found to stimulate the formation of epithelium and hasten cicatrization.

Should secondary collections of pus form in the wound, they will probably cause but little pain, though there will nearly always be a rise of temperature, a coated tongue, and other indications of sepsis of a mild character. Locally the condition may be unsuspected, even on rather careful examination, until the abscess comes very near to the surface, or even ruptures during a change of dressings. Such abscesses should be drained by tubes, and irrigated daily until the cavity has contracted and the discharge become scanty, when the tube should be discarded for slips of gauze. The rapidity with which a tongue, dry and coated for days, will clear up, and become normal after the evacuation of one of these abscesses, is remarkable.

Wounds which have been sutured, and are running an aseptic course, are usually firmly healed in ten days; but unless it has been possible to work through a very small incision, it will be safer to keep the patient in bed for three weeks, in order to be sure that the tendinous structures of the abdominal wall shall have become thoroughly organized along the line of union. When the wound has been left to granulate, the patient may be allowed to get up as soon as cicatrization is complete.

In every case, a support of some kind should be worn for a variable time after recovery. Where it has been possible to secure primary union, a simple belt of webbing, with a flat hard pad to cover the scar, is all that is required. It should be worn for several months, or until the scar has atrophied and turned white. The pad is merely intended to protect the cicatrix from direct injury, not to make pressure. If the patient is inclined to obesity, a wider abdominal support with the pad should be

worn. When the wound has closed by granulation, there is considerable liability to hernia, and a firm support should not be omitted for at least a year, when examination of the scar will determine the proper future course.

Appendicitis Complicating Pregnancy. — The mere existence of pregnancy does not alter in any way whatever the indications for the treatment of appendicitis when it exists coincidently. The diagnosis is, especially in the later months, somewhat difficult, because palpation is not easy, and because various abdominal pains, more or less localized, are common at this time. The cardinal points are just the same as when pregnancy does not exist. The induction of labor is absolutely contraindicated, since it is impossible to say what may be the consequences of the straining of the abdominal muscles and the contractions of the neighboring uterus. Adhesions may certainly be separated, and an ulcerated appendix or a peri-appendicular abscess may be ruptured, with the result of fatal peritonitis. The operation should be done as above described, and suture, or the packing of the wound, practised according to the conditions of infection and the supposed nearness of the labor. When it is probable that labor is imminent, the suture should be especially firm, thick strands of silk or catgut passing through all the layers of the abdomen, in addition to the usual layer-by-layer suture. If packing of the wound is necessary, an additional thick pad of gauze should be laid over the deep packings, projecting on all sides, under the peritoneum, and held firmly in place by long adhesive strips, or, even better, by temporary sutures passing through the abdominal wall, and taking in the gauze itself, but not approximating the edges of the skin. These sutures, together with the gauze compress, may be removed soon after the labor, the wound being dressed in the ordinary fashion, wet or dry as necessity arises.

Typhoid Appendicitis. — The diagnosis of typhoid inflammation of the vermiform appendix is not easily made, since the general

intestinal specific disorder causes symptoms of sepsis with, very frequently, pain and tenderness quite marked in the right iliac fossa. We have to depend, then, upon the severity of the local manifestations, and as an indication of this, no sign is more certain than the rigidity of the abdominal muscles over the affected organ. Perforation will be accompanied, or soon followed, by symptoms of peritonitis, or even collapse. Typhoid fever may itself be mistaken for appendicitis, and though the differential diagnosis is not usually difficult, it may be almost or quite impossible when the lesions of the disease are especially severe near the ileocæcal region. The history of a gradual onset, the characteristic fluctuations of temperature, the presence of spots, and the enlargement of the spleen, should at once put one upon his guard, so that even if the presence of appendical inflammation seems most likely, typhoid fever should not be excluded from the table of probable diseases.

Treatment. — When the diagnosis is clear, operation is demanded in this class of cases even more urgently than in the uncomplicated ones, in order to forestall, if possible, the occurrence of perforation, which, in a patient already weakened by disease, will be most apt to prove fatal, or, if it occurs in the early part of the fever will, even with the help of operative intervention, prove to the already stricken individual an additional obstacle to recovery. No further words are necessary as to the method of procedure. Enlarged mesenteric lymph-nodes will doubtless be observed, and their presence should not cause surprise when the finger, palpating through the wound, detects them.

Appendicitis in the Aged. — This disease, when it attacks old persons, usually runs a more sluggish course than is common with more youthful patients. Delirium is not an infrequent symptom, and its appearance is not here necessarily an indication of profound sepsis. Whenever it occurs after operation, where iodoform has been used, the possibility of intoxication must be borne in mind, and the use of the drug at once discontinued. Unless the vital

forces of the patient are decidedly weak, there need not be so much haste to operate, as when, in younger individuals, the disease takes what might be termed a sthenic course. Indeed, poulticing is not a bad form of treatment here, with a view to increasing suppuration and bringing the abscess within easy reach. When the patient is very feeble, nothing more than incision and drainage should be thought of. If there is recurrent suppuration, the poultice will usually hasten spontaneous opening at the site of the old cicatrix.

CHAPTER XIV

SUPPURATION IN THE LIVER AND GALL-BLADDER

Empyema of the Gall-Bladder. — Suppuration in the gall-bladder is nearly always preceded by retention of secretion within the viscus, due to an obstruction of the cystic or common duct. This obstruction may be temporary; in which case it is usually caused by the passage of biliary concretions, or by inflammatory œdema of the walls of the ducts, or it may be permanent and due to the presence of neoplasms or to impacted gall-stones. It is not necessary that the obstruction should be complete in order to cause retention to such a degree as to invite suppuration. In the majority of cases there has been distention, due to partial obstruction, for a long time, with consequent hypertrophy of the wall of the gall-bladder, before an infection results in true empyema of the organ. Often the passage of calculi, accompanied by attacks of biliary colic, will have preceded impaction and infection. If the tension of a suppurating gall-bladder is not relieved, gangrene with perforation of the vesical wall results. Another danger is suppurative inflammation of the smaller bile passages (cholangitis), which is very likely to prove fatal, even without the formation of actual abscesses of the liver.

Diagnosis. — Since the gall-bladder may be so distended that its fundus reaches far below the umbilicus into the right iliac region, this disease is not infrequently mistaken for appendicitis. When the obstruction in the duct is due to gall-stones, there is usually a history of repeated attacks of colic with or without fever or jaundice. Vomiting will be found to have been present, and

the pain will probably have been referred to the right shoulder, the epigastric and the dorsal regions, the dorsal pain being a particularly important diagnostic point. In ascertaining the probability of the existence of jaundice during previous attacks, it should not be forgotten that there may be clay-colored stools with very little cutaneous and conjunctival pigmentation.

The present illness may have begun with colic or with dull pain, referred to the right hypochondrium, the epigastrium, and the dorsal region. There is loss of appetite, and usually constipation. Jaundice may not have been present at first, though it generally develops as the disease progresses. There may be chills, and there is almost invariably an elevation of temperature, which varies with the character of the sepsis. Some change in the pulse-rate, usually an acceleration, is the rule. The disease is not, in most instances, acute after the onset, but when, following the lapse of days, or even weeks, gangrene is imminent and perforation is threatened, the symptoms may suddenly assume a most alarming character, clearly indicating that unless speedy relief is afforded fatal complications will ensue. The patient at this time presents the clinical picture of one who is septic. The face, however, even now, has not the peculiar anxious look of one who is suffering from acute appendicitis. The patient seems to have become used to being sick, and is apathetic both in manner and appearance. The pulse and temperature should be observed rather as indications of the vital condition than as helps in the diagnosis of the ailment. The tongue will be found coated and often dry.

Abdominal palpation is the most important means of diagnosis at our disposal. It will be noted that the patient, while evidently suffering from the examination, does not flinch from our lightest touch, as does the one who suffers from acute appendicitis; and that while there may be considerable rigidity, the reflex spasm is not so marked, the patient seeming to be better able to relax himself at will. The individuals who are apt to suffer from empyema of the gall-bladder are often obese, and palpation may

present great difficulty. The distended viscus is not, like the appendix, frequently hidden away in a more or less inaccessible place, but is pretty constantly situated directly beneath the abdominal wall, continuous with the liver, and projecting from under the ribs in the right hypochondrium downward in the mammillary line. When there is great enlargement of the liver, it is true, there may be insurmountable difficulties in the way of palpating the gall-bladder, but this is not common, the viscus usually projecting well beyond even a swollen liver. Palpation should be performed from two directions. First, by sliding the skin over the underlying tissues from the median line outward, the hands being held as described on page 236. (Fig. 109.) By this method the presence of a tumor or longitudinal resistance will be ascertained. The next step is the most important one. The tips of the fingers of the right hand, the palm toward the liver, should be pushed into the iliac fossa, and with a gentle side-to-side motion drawn upward toward the right nipple, the fingers all the while being flexed, and the palm of the hand resting upon the abdomen. (Fig. 120.) The globular, elastic fundus of the gall-bladder will be felt, in most cases, with such distinctness that it is unmistakable, even when the tumor occupies a position low down in the iliac fossa. As corroborative evidence we have the continuousness of the tumor with the liver, and the dulness on percussion, with the absence of a tympanitic note where the colon crosses. The presence of this tympanitic note, however, does not necessarily change the diagnosis if the other points are clear, for especially in cases where there is much general distention, a note may be transmitted so perfectly that the distance of the hollow organ from the surface cannot easily be estimated.

When gangrene and perforation has occurred, there may be no palpable tumor, or if the viscus has perforated after adhesions have formed, the mass is more irregular in outline and less tender on examination than is the tense intact viscus. With the progress of the inflammation, the omentum or the coils of neighboring intestine usually become adherent to the wall of the gall-bladder;



FIG. 120.—Palpation of the gall-bladder. The right hand detects the distended viscus.

but adhesions are not found so early in the disease as they are in acute appendicitis, a gall-bladder full of pus and in a high degree of inflammation often remaining free from attachment to surrounding organs or to the parietal peritoneum.

Treatment: Cholecystotomy in the Absence of Important Adhesions. — Incision and drainage of the infected viscus is the correct form of treatment, as soon as the diagnosis of suppuration is made. When there is deep jaundice, hemorrhage is, at times, severe. Hemostasis is then of the utmost importance, so even the smallest bleeding points should be secured by ligation.

If the individual is small or emaciated, and the tumor very superficial and easily palpable, the operation may be undertaken without general narcosis, local anæsthesia by eucaine being sufficient; but when the patient is obese and the gall-bladder not

easily mapped out, general anæsthesia should be preferred. The anæsthetist and at least two other skilled assistants will be required. The instruments are the following: a scalpel, a pair of large, sharp retractors, a pair of medium-sized blunt retractors, eight artery-forceps, two mousetooth-forceps, a dressing-forceps, other blunt but slender grasping-forceps of any kind which the operator may possess, a large-buttoned probe, needles, a needle-holder, and a pair of scissors, besides sponges, sutures, ligatures, and dressings.

The incision is made along the line of the tumor, but not to its lowermost limit. (Fig. 91.) It should not be less than three inches in length, so that one may work with the aid of sight without the danger of rupturing adhesions or even the gall-bladder itself by blind manipulation. The dissection should be done according to the principles described in Chapters IV., XI., and XIII. Having opened the peritoneal cavity, the tumor should be inspected and then carefully palpated with the finger.

If no adhesions cover the gall-bladder, which will usually be found very tense and of a dark red color, the index and middle fingers of the right hand, the pulps toward the viscera, should be slipped into the lower angle of the wound and round the fundus of the tense viscus, which may be carefully brought out of the wound. If, now, the patient's condition is poor and speed is an object, the gall-bladder may be held in position with the help of two or three silk sutures fastening it to the skin, taking care that the visceral wall shall not be perforated. Then, carefully packing gauze into the peritoneal cavity around the exposed portion of the viscus, a thick circular pad of gauze should be laid round the wound to prevent pressure by the dressings. This completes the first step. If the condition of the patient is favorable, however, and there is no need of haste, it is better to stitch the peritoneum to the skin by rather stout silk sutures, and then to sew the projecting portion of the gall-bladder to the peritoneum, using many fine silk sutures so as to make the approximation as close as possible. The opening in

the peritoneum should be closed above and below the gall-bladder, and if it has been necessary to make a large wound through the abdominal wall, this may be diminished by placing a few deep sutures at the angles. If the tension within the gall-bladder is such that in the present condition of that organ perforation seems imminent, or

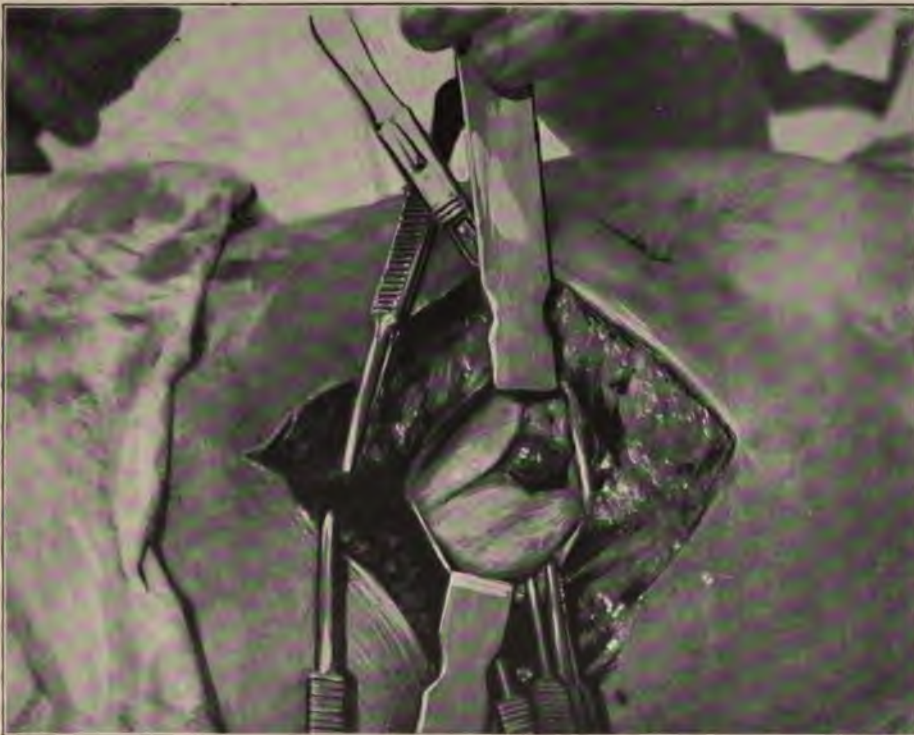


FIG. 121.—Cholecystotomy in a very obese patient. A portion of the tense gall-bladder is seen. The remainder is covered above by the enlarged liver and below by adherent omentum. The patient is lying with her head to the left of the picture.

if there was great pain, a portion of the contents may be withdrawn with the aspirating syringe, and the puncture closed by suture. This is nicely done in the following manner. Running a non-perforating purse-string suture in a small circle round the point of intended puncture, and tying the ends in a single knot without

tightening it, the aspirating needle should be inserted at a point within this circle, and as much fluid as desirable drawn off. The ends of the suture may then be tightened, and the needle simultaneously withdrawn. The second knot being now tied, the closure of the puncture is secure. Not rarely, when the disease is of long standing, the first part of the fluid withdrawn will be clear



FIG. 122.—The same case as Fig. 121. The gall-bladder has been freed from its adhesions and isolated with gauze packings.

and unstained by bile, the pus appearing later from the lowermost portion of the gall-bladder, where it has gravitated. Unless there is some particular reason for haste, it is better to defer the opening and exploration of the interior of the gall-bladder for two or three days following the first step of the operation. This is especially important where no complete suture of the viscus to the abdominal wall has been possible. The opening of the gall-bladder is not a painful procedure, so no anæsthetic whatever will be required.

An incision, an inch or more in length, may be made with a sharp-pointed scalpel, and the interior of the organ explored with the finger. If calculi are found, they may be removed by irrigation with a full stream of some mild antiseptic solution, the gall-bladder wound being held apart with retractors. Forceps may also be employed, passing them along the finger as a guide, so as to avoid the accidental laceration of the mucous membrane. Having removed as many of the concretions as are easily accessible, the cystic duct, which in these cases is usually very much dilated, should be explored with the finger and with a large-buttoned probe. The larger stones which cause the obstruction when they become impacted are often found here. They are usually spheroidal in shape, while the multiple calculi of the gall-bladder proper are faceted. They may often be loosened and removed with forceps, or, if of the soft variety, crushed and taken away piecemeal. It sometimes happens that it is impossible to remove large impacted stones by these methods. Another operation will, then, possibly be demanded at some future time. A large, soft, drainage-tube should be placed within the gall-bladder, and the remainder of the wound packed and dressed. One or two stout chromic gut sutures should be put in at each side of the tube across the line of incision, in such a manner as to cause complete inversion of the mucous membrane of the gall-bladder. This insures very rapid closure of the visceral wound when the tube is removed. Long adhesive strips placed over the packings will draw the wound together so as to guard against accidental protrusion of the viscera.

Cholecystotomy in the Presence of Adhesions. — When, on opening the abdomen a mass partially or completely covered by injected omentum is seen, or where there are coils of intestine adherent to a tumor which will probably turn out to be the gall-bladder, it is best to enlarge the incision, especially downward, and to proceed to wall off the free peritoneal cavity with gauze placed around and beneath the gall-bladder, before making any attempt to develop the inflamed viscus by peeling away the adhesions.

If spots of gangrene or, perhaps, one or more perforations are discovered, the entire wound should be treated by the open method, walling off the uninfected portion of the abdomen with thick, firmly placed gauze packings. If unperforated, the gall-bladder should be aspirated so as to reduce the tension and the quantity of septic contents, then widely opened, and any calculi which may be present removed. The cavity should then be packed with gauze around a drainage-tube, extending toward the cystic duct. Adhesive straps should be placed over the pad of gauze next to the wound, and this dressing covered by a thick mass of absorbent material held in place by a binder. The outer gauze should be changed as often as it becomes soiled, but the inner part may remain undisturbed for twenty-four hours. If the packings in the peritoneal cavity are having the desired protecting effect they should be allowed to remain for four or five days, or even longer, unless there is reason to suspect the formation of pus beneath them.

When the adhesions can be peeled away, revealing an inflamed but not gangrenous gall-bladder, the method of procedure will be the same as when the viscus is non-adherent; suture of the gall-bladder to the skin, or packing away with gauze, being practised, according to the exigencies of the case.

Diffuse peritonitis, due to infection from a suppurating gall-bladder, will be treated of in Chapter XVI.

When sutures have been employed to hold the abdominal wound, they must be very stout, and should remain in position for at least ten days, since there is great danger that wounds in this portion of the abdomen may be forced open by straining or coughing. The button suture is applicable here. (Page 62.)

After-Treatment. — Morphine will in most cases be required in doses sufficient to allay pain for the first twenty-four or thirty-six hours. The bowels should be moved early, preferably with the help of calomel and salines given in the manner described on page 206, and followed by enemata. The stools should be examined for calculi and also to note the presence of bile-pigment. It

must not be forgotten that bismuth, iron, and other drugs may cause a darkening or blackening of the feces, which should not be mistaken for the normal bile-staining. At the same time the urine must be frequently examined, in order to note the gradual disappearance of bile.



FIG. 123.—Granulating cholecystotomy wound. The dressing-forceps is in the gall-bladder.

The directions as to nourishment are practically the same as those given in the chapter on Appendicitis.

The patient, even under the best conditions, should not be allowed to sit up in bed before the expiration of three weeks from the time of operation.

The tube should be kept in the gall-bladder until cicatrization has begun, and daily irrigations of the viscus with saline solution should be performed. Even when but a small opening remains,

the tube having been long removed, there may be a profuse biliary discharge. When the opening has become very minute, repeated actual cauterization will hasten its contraction and closure. The occurrence of pain, with swelling and tension of the gall-bladder after the wound has closed, shows the existence of a more or less permanent obstruction in the cystic or common duct. When the obstruction is cystic only, there will be no jaundice, and the secretion in the gall-bladder will probably be very pale in color, and often perfectly limpid; while if there is obstruction in the common duct, there is jaundice, and the secretion in the gall-bladder consists of bile or distinctly bile-stained fluid. In either case the old cicatrix will soften under warm moist applications, and will probably reopen. It should not be permitted to close again for a number of weeks.

All patients who have been subjected to cholecystotomy should wear a binder with a firm, *flat* pad as a guard against hernia.

Abscess of the Liver.—Hepatic suppuration is of various anatomical forms. There may be a solitary abscess, several discrete abscesses, or multiple foci of infection. The smaller multiple abscesses may coalesce, forming large cavities, or even a solitary abscess, though usually suppuration of the type under discussion is fatal before this occurs.

The usual causes of abscess of the liver are direct infection following traumatism, and the deposition of septic material, carried to the liver by the blood current. Infection from some diseased portion of the alimentary tract which empties its blood into the portal vein is a not infrequent source of the malady, especially in tropical countries. Hepatic abscess may be secondary to an acute appendicitis, making its appearance long after the appendicular inflammation has subsided. Acute pyelephlebitis, which is almost invariably fatal, may occur during the course of appendicitis.

Diagnosis.—In the early stages, the diagnosis of abscess of the liver is one of extreme difficulty. The history is that of vague pain, with fever and general deterioration. Jaundice is uncom-

mon, unless there is pressure upon the bile-ducts. The patient suffers from a slow form of sepsis. When the collection of pus has attained a large size, however, the difficulties in recognizing the condition greatly diminish.

There is a history of illness, usually of several weeks or even months in duration. The patient looks septic, with or without jaundice. Not infrequently there is diarrhœa. Emaciation and weakness are marked. The temperature is generally elevated, and the pulse increased in frequency, but diminished in strength and volume. Respiration is usually accelerated. The appetite is poor, and sleep is disturbed. There may be pain or tenderness referred to the right hypochondrium or the right shoulder. On percussion the liver dulness will be found enlarged, and the organ plainly palpable beneath the costal border. Abscesses are most frequently found in the right lobe, which is the seat of most of the enlargement. At times, when the abscess has become superficial, deep fluctuation may be detected toward the loin. Œdema of the overlying skin is a late sign.

Operation. — General narcosis is desirable. An anæsthetist and two other medical assistants will be required, one or two lay helpers being also of advantage. The list of instruments is: a scalpel, large, sharp retractors, medium-sized blunt retractors, six artery-forceps, a dressing-forceps, a pair of scissors, two mouse-tooth-forceps, a bone-cutting forceps, a periosteum elevator or raspatory, a probe, a grooved director, a needle-holder, needles, sponges, ligatures, dressings, and an aspirating syringe. An irrigator with saline solution should also be ready.

Unless fluctuation is plainly to be made out anteriorly, these abscesses should be opened from behind, in such a manner as to prevent the soiling of any part of the abdominal cavity. A four-inch vertical incision down to the ribs should be made a little behind the posterior axillary line, its lowermost point being at the ninth rib. Sections of about two inches should be taken from two of the ribs, say the seventh and eighth (see Chapter X., page 183),

and the periosteum divided down to the costal pleura. This membrane should be peeled by blunt dissection from the upper surface of the diaphragm, and held out of the way, with the aid of a blunt retractor, protected with a covering of gauze. Accidental wounds of the pleura should be repaired by suture. The aspirating needle may now be used to ascertain the exact location of the pus cavity, plunging it through the diaphragm into the liver. Having drawn a few drops of purulent fluid into the syringe, the needle should be detached, but left in position in the tissues, and along this, as a guide, a slender, blunt instrument, such as a thick probe or a grooved director, should be passed into the abscess, previously laying gauze around the site of the proposed opening, over the severed ends of the ribs, in order to prevent, as far as may be, the spreading of infection. A slender dressing-forceps, inserted with its jaws closed, should be withdrawn while they are separated, so as to tear an opening in the abscess wall. These abscesses sometimes contain enormous quantities of pus. Two stout drainage-tubes fenestrated, as shown in Fig. 57, page 95, should be laid into the cavity, and thorough irrigation performed. If there is not much oozing of blood, these tubes may be left in, gauze packings being inserted in addition; but if the hemorrhage is quite profuse, it is best to pack the entire cavity with gauze, laying in a sheet of two thicknesses as a lining, and stuffing this full of strips, the ends of which should be left protruding, in order to facilitate their subsequent removal. The tubes may be inserted later, when the danger of hemorrhage is past.

When it is deemed best, on account of the location of the abscess, to open anteriorly, the incision should be made parallel with the costal border, at a variable distance from the ribs. If there are no adhesions between the liver-surface and the parietal peritoneum, it is best to postpone the incision into the liver itself, packing gauze between liver and abdominal wall so as to cause the rapid formation of adhesions. The abscess may then be opened two or three days afterward in the manner just described.

After-Treatment.— There is often considerable shock immediately after the evacuation of a very large abscess. This condition is to be combated according to the principles enunciated in Chapter IV. The outer dressings must be changed as soon as they have become soaked, but the packing should not be removed for two or three days. They may then be renewed or the drainage-tubes inserted, according to the amount of discharge, the tubes being usually more satisfactory than gauze when the flow is profuse. After this the wound should be dressed once or even twice in twenty-four hours, until the cavity has contracted, and the discharge diminished sufficiently to make this no longer necessary. Irrigation with saline solution should be practised at each dressing. At first the discharge will be very deeply stained with bile, a large proportion of the total biliary secretion coming away by the wound. Its diminution is a favorable sign.

CHAPTER XV

STRANGULATED HERNIA

Strangulated Hernia. — A hernia is the protrusion of a viscus from the cavity which normally contains it. When a constriction forms about the neck of a hernia so as to interfere with the circulation of the protruded mass, the condition is called that of strangulation. It is usually caused by some strain which forces an unusually large mass through the neck of the sac. Strangulation of herniæ which contain abdominal organs is dangerous to life, since gangrene will result, with consequent sepsis, peritonitis, and death. The strangulation of any abdominal organ, even when merely the omentum or an epiploical appendage is involved, starts a train of evil symptoms which will not permanently subside until the constriction is relieved or life is extinct. These symptoms are persistent vomiting, great thirst, more or less pain in the region of the hernia, and pain of a cramp-like character at the umbilicus. Later, the symptoms of intestinal obstruction appear, with peritonitis, distention, the vomiting of feculent matter, acceleration and weakening of the pulse, shallow respiration, and, finally, death. A group of symptoms like this should in any case suggest careful examination as to the presence of strangulated hernia. The duration of the disease, if untreated, depends upon the part involved and the tightness of the constriction. Gangrene may come on in a few hours, or the strangulation may last for a number of days without its supervention. The symptoms are most severe when intestine or bladder is contained in the hernial sac.

An abdominal hernia may occur almost anywhere through the belly wall, through the left half of the diaphragm into the thorax, through the obturator foramen, through the sciatic notch, through the loin, through the linea alba at any level, and through the inguinal, femoral, or umbilical ring, the last three being by far the most frequent varieties.

When strangulation has set in, one of the first things to happen is the accumulation of fluid in the sac. This is due for the most part to the exudation of serum through the vessels of the constricted tissues, because the heart continues to force blood into the hernia by way of the arteries, after the more feeble outflow through the veins has ceased. It seems to be an effort of Nature to reduce the hernia by fluid pressure. Percussion over the hernial tumor may elicit a tympanitic note, which indicates that a portion, at least, of the contents of the sac is intestine. The absence of this note, however, does not invariably show that intestine is not involved. At the beginning of the attack, palpation may give information as to the presence or absence of omentum; but when the fluid has tensely distended the sac, it may be impossible to ascertain before operation what organ or organs are strangulated.

Treatment.— Gentle efforts to reduce the hernia by taxis may be made, in no case lasting longer than ten minutes. Then, while preparations for operation are going on, an ice bag should be applied over the tumor, and the patient placed in such a position that the involved viscera may be drawn upon by the force of gravity. If, for example, we are dealing with an inguinal hernia, the patient should be so placed that the hips are elevated well above the shoulders. Immediately before operating, when the patient is under the influence of the anæsthetic, another gentle attempt may be made at reduction. Frequently, after the application of the cold, and under the relaxing effect of the anæsthetic, strangulated herniæ become reducible. The operation for radical cure should never be undertaken after reduction by this method, but should rather be delayed until the patient has thoroughly recovered his

normal state. If the symptoms persist after reduction, the probability of strangulation by adhesions must be borne in mind. The case then becomes one of intestinal obstruction.

Herniotomy. — Unless the patient is slender and courageous enough to bear the infliction of considerable pain, even with the aid of eucaïne, general anæsthesia should be employed. An anæsthetist, at least one lay assistant, and two medical assistants should be at hand. The instruments are as follows: a scalpel, preferably one with considerable "belly," eight artery-forceps, two pair of scissors, one curved and one straight, sharp retractors, small and large blunt retractors, two mousetooth-forceps, a dressing-forceps, needles, a needle-holder, and forceps which may be used as sponge-holders. For the latter purpose, long slender uterine-forceps will do. Sponges, sutures of chromic catgut and plain catgut, and dressings must also be ready.

If general anæsthesia is to be employed, lavage of the stomach should never be omitted, the case being looked upon as, clinically, one of intestinal obstruction. The anæsthetic should be administered with the greatest caution, and the alarm given by the narcotizer with the very first sign of danger. In old persons, especially, the estimate of the general vital condition before operation may be very deceptive, the first few whiffs of the anæsthetic being followed by symptoms of collapse which, if unheeded, may quickly become most alarming.

Strangulated Umbilical Hernia. — An ample longitudinal incision should be made over the hernial region down to the aponeurosis. In passing over the tumor, it will probably be noted that the skin is so thin and the sac so superficial, that unless due caution is observed, the latter may be prematurely opened. Having exposed the aponeurosis over a region adjacent to the neck of the hernia, the edges of the wound should be widely retracted by one assistant, while a second draws the hernia upward, downward, or to one side, in such a manner as to aid the laying bare of the neck or constriction. The sac, now thoroughly exposed by dissection, may be incised between

mousetooth-forceps. (Fig. 124.) Almost invariably this is followed by a spurt of liquid. The presence of bloody fluid shows the severity of the strangulation. The color of the hernial contents indicates the probability of their viability. The presence of a fecal or putrid odor is an evil sign. Even after a comparatively short period of strangulation, it will be noted that the involved tissues are cold. The neck of the hernia may now be incised to such an extent that more intestine or omentum or both can be easily withdrawn from the abdomen, in order that the constricted tissues themselves may be inspected, and the strangulated parts compared with the more healthy structures continuous with them within the abdomen. Omentum which does not readily regain its normal color and consistency, should be ablated after carefully ligating it in small sections with fine catgut. Great caution is to be observed in placing these ligatures, since the slipping of a single one, after the abdomen has been closed, may cause fatal concealed hemorrhage. Intestine which is not actually gangrenous may regain its vitality, even when its walls have become stiff and lustreless. No matter how dark the color, a bluish hue means that gangrene has, perhaps, not occurred. A grayish or greenish tint, however, especially if the discoloration takes the form of spots or blotches on the intestinal wall, is less favorable. Gangrenous intestine is soft and of putrid odor.

Having drawn out several inches of the normal gut, continuous with each end of the diseased portion, the entire mass of diseased and healthy intestine should be wrapped in a very warm towel, with as little tension as possible on the mesentery, and saline solution, six-tenths per cent., should be gently poured over it for several minutes, from a pitcher or an irrigator. If the strangulated portions tend distinctly to resume their normal color, and if they contract on being bluntly pinched, the protruding coils may be all replaced within the abdominal cavity, and the wound closed. If the return to a normal appearance seems doubtful, the affected coils should be surrounded with gauze placed so as to guard the

peritoneal cavity against infection, and one or two temporary sutures at the legs of the intestinal loop should be put in, sewing the gut to the skin in order to prevent its accidentally slipping back into the abdomen. No effort should be made to close the wound. Sterilized gutta-percha tissue (page 191) should be placed in contact with the intestine, and a thick ring of gauze so arranged as to prevent pressure on the exposed parts. (Fig. 188.) Packings and a wet saline solution dressing complete the treatment for the present. In six hours the wound may be again inspected, when the viability of the intestine will have been pretty certainly determined. If the circulation has returned, and the parts are obviously assuming their natural color, the packings may be removed and the coils of intestine replaced within the abdomen. If it seems desirable, and the condition of the patient will permit of further manipulation, closure of the wound by suture may then be performed without anæsthesia. Unless the tension is very great, the layer-by-layer method with chromicized gut will give satisfaction.

If there is difficulty in bringing the edges of the wound together, deep, stout, button sutures of silkworm gut or silk may be used in addition. In neither case is it wise to close the skin wound. Firmer union and less likelihood of relapse may be obtained by excising the umbilical ring well into the recti, which should be united by sutures, not through the muscles themselves, but through the posterior and anterior sheaths. If it is thought unwise to prolong operative procedures, the intestines may be replaced and covered by a gauze pad large enough to project under the parietal peritoneum for about an inch all around the wound. Over this pad gauze packings should be placed, the whole being covered by adhesive strips and a firmly fitting binder or bandage.

When it is found that the intestine is actually gangrenous, our course should be governed by the condition of the patient. If this is so bad that stimulation has been necessary, or if, for any reason, it is feared that he may not be able to stand further operation, the entire gangrenous portion should be left in the wound with pack-

ings around it. If the knuckle is small, or if there seems to be a tendency for the coils to slip back into the abdomen, they should be stitched to the skin by each leg of the loop. The gangrenous portions will, in due time, slough away, and an intestinal fistula or an artificial anus will result; a condition which may be remedied by future operation. This disagreeable and sometimes dangerous complication should, however, be avoided by resection of the gangrenous portions of the intestine, if the patient appears able to endure a longer operation. In making the resection, every bit of doubtful gut should be sacrificed, and the anastomosis should be made through perfectly normal tissues. It often happens that there are little spots of necrosis at an astonishing distance from the main patch of gangrene. One should, therefore, be careful to inspect the supposed healthy gut for about eight or ten inches beyond the limits of the excised portions. (For the method of making the resection and anastomosis see Chapter XI., page 198.)

Strangulated Oblique Inguinal Hernia.—The assistants, the requirements as to anæsthesia, and the list of instruments are the same as described above.

Very thorough disinfection is required, because of the difficulty of rendering this region surgically clean. If the patient is a male, the penis should be scrubbed and then bandaged with a piece of sterilized gauze. The pubes, the scrotum, and the upper portion of the thighs should be smoothly shaven. An incision traversing the hernial protrusion should be made parallel with Poupart's ligament. The upper limit of this incision must be at least as high as the internal ring, but its lower limit need not, in most instances, extend into the scrotum. (Fig. 91.) Having exposed the aponeurosis where its fibres run forward and inward forming Poupart's ligament, the neck of the hernia should be sought. The dissection between two mousetooth-forceps may now proceed upon the tumor itself, in order to identify the sac. Such vessels as are encountered should be secured before they are divided. The unopened sac usually has a dark bluish hue from the contained fluid. Its

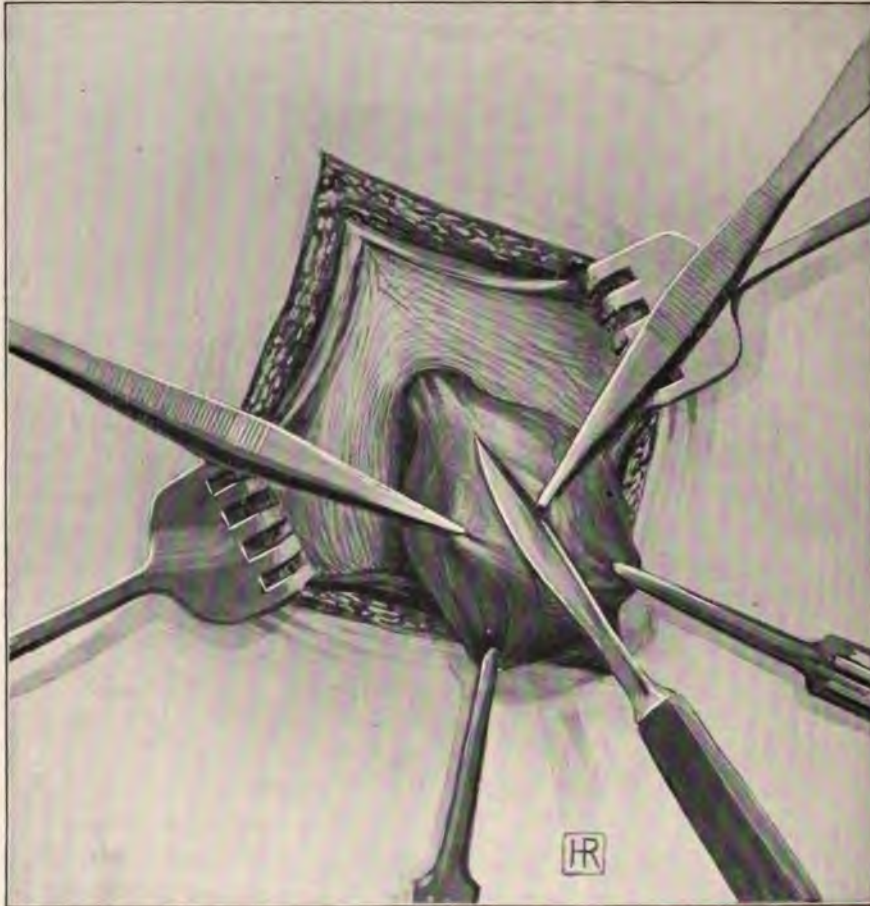


FIG. 124. — Operation for the cure of oblique inguinal hernia. The sac is pulled down toward the scrotum, exposing the neck, and is about to be incised.

wall should be carefully raised away from any viscera which may be contained, and cautiously nicked with the scalpel. (Fig. 124.) A gush of serous liquid announces that the sac has been entered. The opening should be amply enlarged, and the edges of the sac at once grasped with artery-forceps (Fig. 125), so that the structure may be easily and quickly identified during the remainder of the operation. The contents of the hernia are now inspected, and

after the constriction has been relieved (Fig. 126) they are dealt with according to the directions given on page 281 regarding umbilical hernia. If an inflamed vermiform appendix is encountered it should be ablated after ligation. (See page 242.)

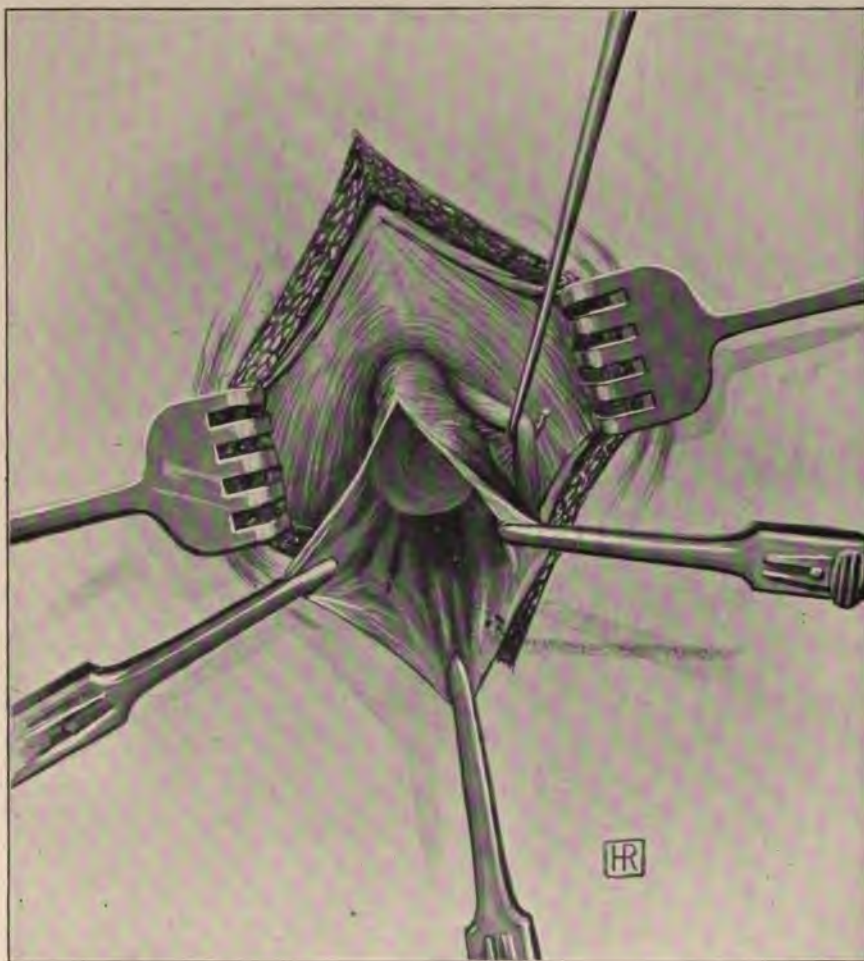


FIG. 125.—The sac has been incised and is being held open with the aid of artery-forceps. The strangulated contents are seen. The spermatic cord has been freed and is held up with a blunt hook. It is not always advisable or possible to isolate the cord at this stage of the operation.

The urinary bladder may form part of the contents of the sac. It is, of course, extra-peritoneal, so theoretically it is not really in the sac. Its presence should always be thought of as a possibility. Having once been seen, it will hardly go unrecognized a second time. If it should by accident be incised, the appearance of the mucous membrane and the thickness of the vesical wall will at once cause suspicion. The odor of the escaping urine makes the suspicion a certainty; but if there is no urine, the opening should be enlarged so that the finger may be inserted for exploration. The opening in the bladder should be at once closed by suture (see Chapter XVIII., page 324), and a permanent catheter should be tied in the urethra for several days, or at least until it gives rise to irritative symptoms. If the bladder has been injured, it will be unwise, even after suture, to attempt a radical cure of the hernia at the same time.

The constricting tissues should be cut from without by dissection through the neck of the hernia with the aid of mousetooth-forceps, securing vessels before they are severed. If gangrenous tissues are present in the sac, all fluid should be wiped away before the constriction is relieved, and the gangrenous contents secured so that they shall not slip back into the peritoneal cavity when the obstruction is removed.

If the patient's condition is poor and no gangrene is present, the operation may now be quickly ended by packing the entire wound with gauze, one strip being placed just within the abdomen. A firm spica will prevent protrusion of the viscera. Within a day or two firm adhesions will have formed, further obviating this accident.

A wound of this sort should be dressed after three days, or sooner if unwelcome symptoms make it necessary. After the first dressing, the wound must be inspected daily, until granulation is well under way. The patient should wear a truss with a soft pad until the cicatrix has whitened, when a firmer pad may be applied.

Radical Operation. — Where the hernial contents are in good condition, the question of radical treatment for the cure of the rupture must be considered. If the patient is very old or feeble,

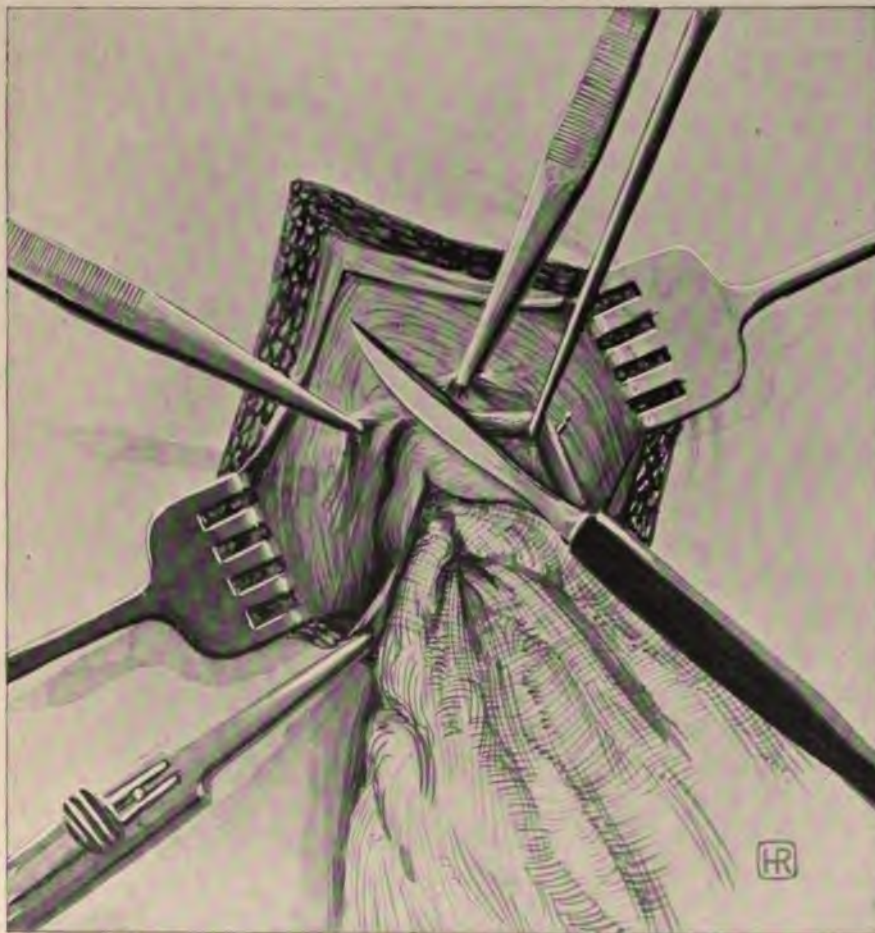


FIG. 126. — The constricting tissues are being divided and the anterior wall of the inguinal canal slit up toward the internal ring. The gauze packing prevents prolapse of the abdominal viscera.

this idea should not be entertained; but if we are dealing with a young or middle-aged healthy individual, a radical operation should be performed if, after the relief of the constriction, it seems proba-

ble that prolonging the anæsthesia will not endanger the patient's chances of recovery.

Having reduced the contents of the sac, protrusion should be temporarily guarded against by a gauze packing, one end of which must be left out of the wound, and in plain sight, so that the gauze may not be lost in the abdominal cavity. The entire thickness of the anterior wall of the inguinal canal should be slit up as far as the internal ring, and the spermatic cord, in the male, dissected away from the sac. (Fig. 126.) This proceeding may be facilitated by occasionally holding the tissues toward the light, spreading them out so as to render the vas deferens and the vessels of the cord visible as opaque objects when viewing the parts by transmitted illumination.

The cord having been isolated, the gauze packing may be removed from the abdominal cavity; and while the viscera are held back with the aid of a slender instrument of some kind, such as a forceps or sponge-holder, the neck of the sac may be transfixed and ligated as the sponge-holder is withdrawn. Great caution should be observed that no bit of omentum or intestine is caught in this ligature. (Fig. 127.) The distal portion of the sac is left in or dissected out according to the need for haste in completing the operation. If we are treating a congenital hernia it may be difficult or even impossible to clear the cord perfectly. A sort of purse-string suture, not including the cord, should be put in at the neck of the sac so as to close it, the distal portion, which is also the tunica vaginalis, being left open. The next step is the most important one in the operation. While an assistant holds the spermatic cord upward with the help of a blunt hook (Figs. 125 to 130), sharp retractors should be inserted into the edge of the aponeurosis and into the edge of Poupart's ligament, so as to expose on the one side the conjoined tendon, and on the other the under part of the ligament. With a hemostatic needle and medium-sized chromic gut, sutures are to be passed through the conjoined tendon and neighboring muscular wall, uniting them to the under surface of Pou-

part's ligament as it appears in a fold where its edge has been drawn away by the retractor. (Figs. 128 and 129.) In passing these sutures a good hold upon the conjoined tendon should be taken,

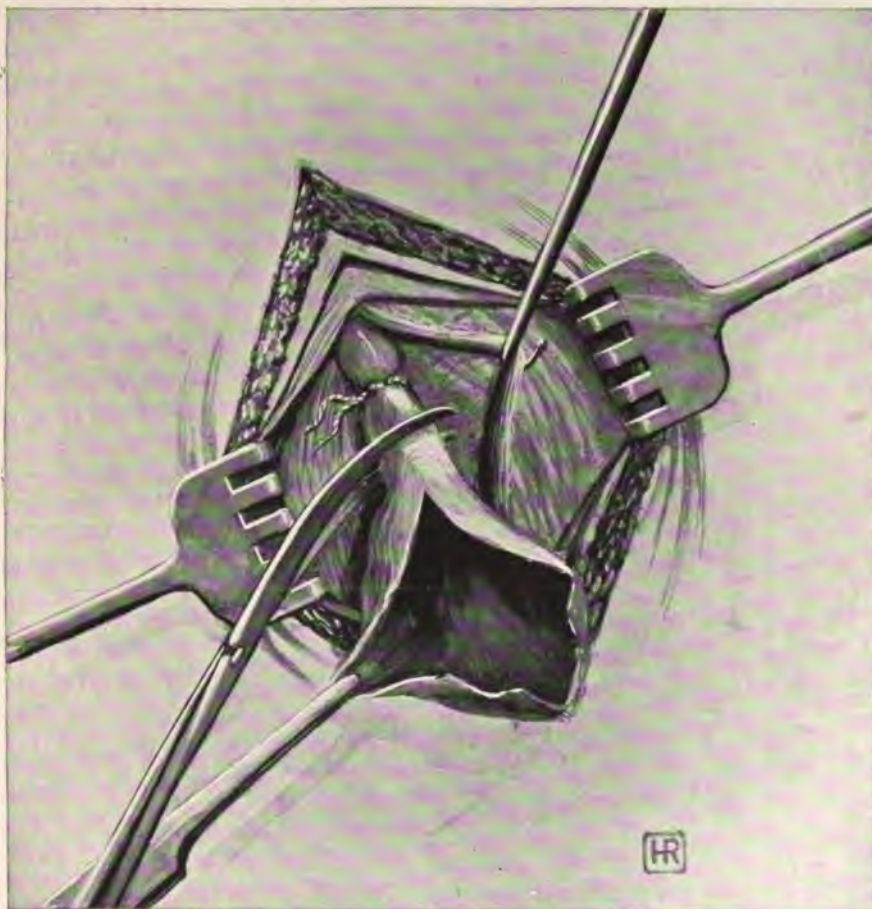


FIG. 127.— Its neck having been ligated the sac is being ablated. The anterior wall of the inguinal canal has been opened.

while on the side of the ligament the greatest care must be observed not to injure the external iliac artery, which is very near. The vessel should invariably be felt with the finger before each suture is passed. (Fig. 128.) It is well not to tie the sutures until all

are in place, keeping them from getting entangled in the meantime by clamping the ends of each one with artery-forceps. While these sutures should be very firmly knotted, they should not draw

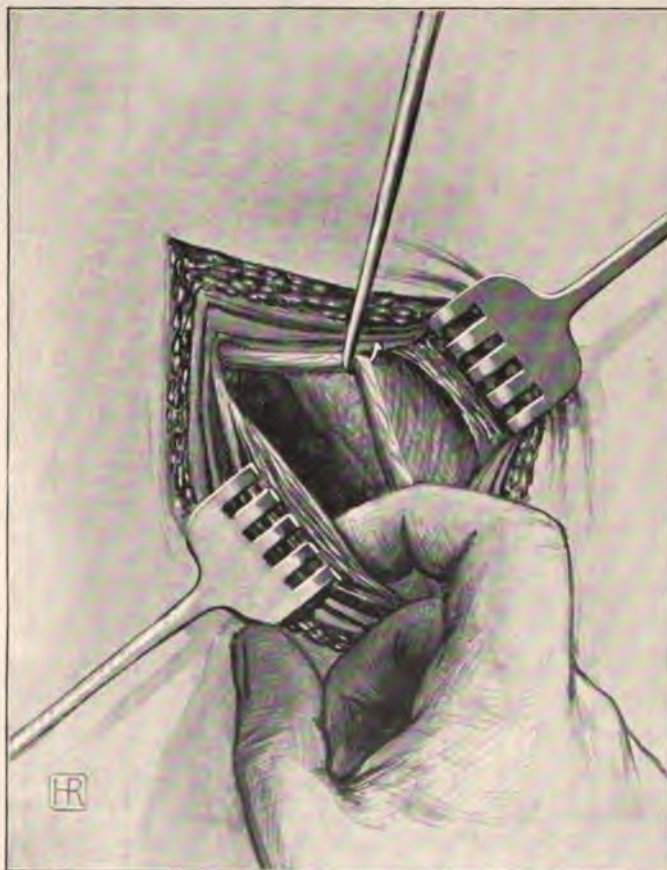


FIG. 128.—The ligated neck of the sac has retracted. The edge of Poupart's ligament is held back by the sharp retractor, exposing its under surface. The finger is feeling for the external iliac artery. The other sharp retractor holds the skin and aponeurosis, exposing muscle and conjoined tendon.

the tissues together so tightly as to cause necrosis. From four to six sutures are usually sufficient to close the opening and form the deep or posterior wall of a new inguinal canal. (Fig. 130.) The spermatic cord may now be laid upon this wall, and, changing the retractors to the skin, the edge of Poupart's ligament should be sutured to the edge of the aponeurosis, thus covering the cord, and forming a superficial or anterior wall for the new inguinal canal. It is best not to close the cutaneous portion of the wound by sutures, but to pack it lightly with gauze and draw it together with adhesive straps

the tissues together so tightly as to cause necrosis. From four to six sutures are usually sufficient to close the opening and form the deep or posterior wall of a new inguinal canal. (Fig. 130.) The spermatic cord may now be laid upon this wall, and, changing the retractors to the skin, the edge of Poupart's ligament should be sutured to the edge of the aponeurosis, thus covering the cord, and forming a su-

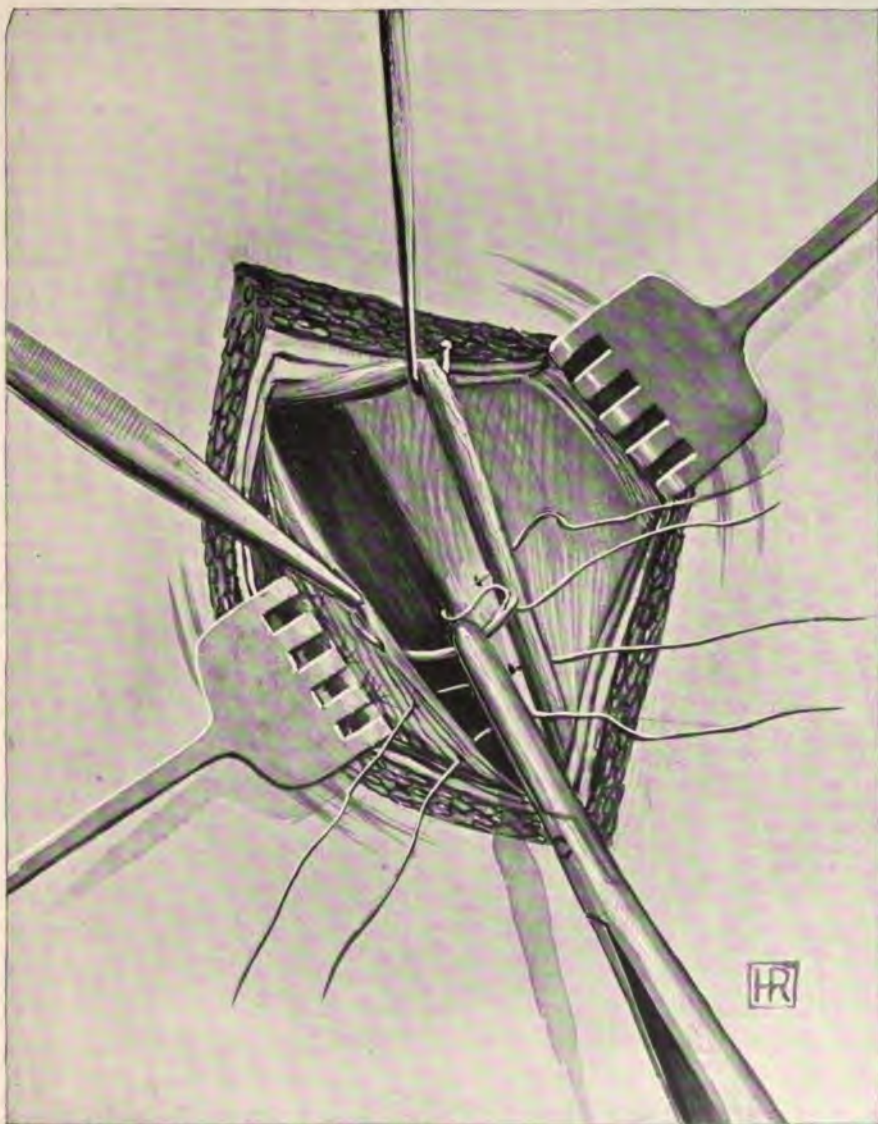


FIG. 129. — Passing the deep, important sutures through the conjoined tendon and the under side of Poupart's ligament exposed by the retractor. The cord is held out of the way.

when granulation is well under way. In the female, the steps of the operation are the same, with the exception of those relating to the cord. If the round ligament is well developed, it may be treated as the cord.

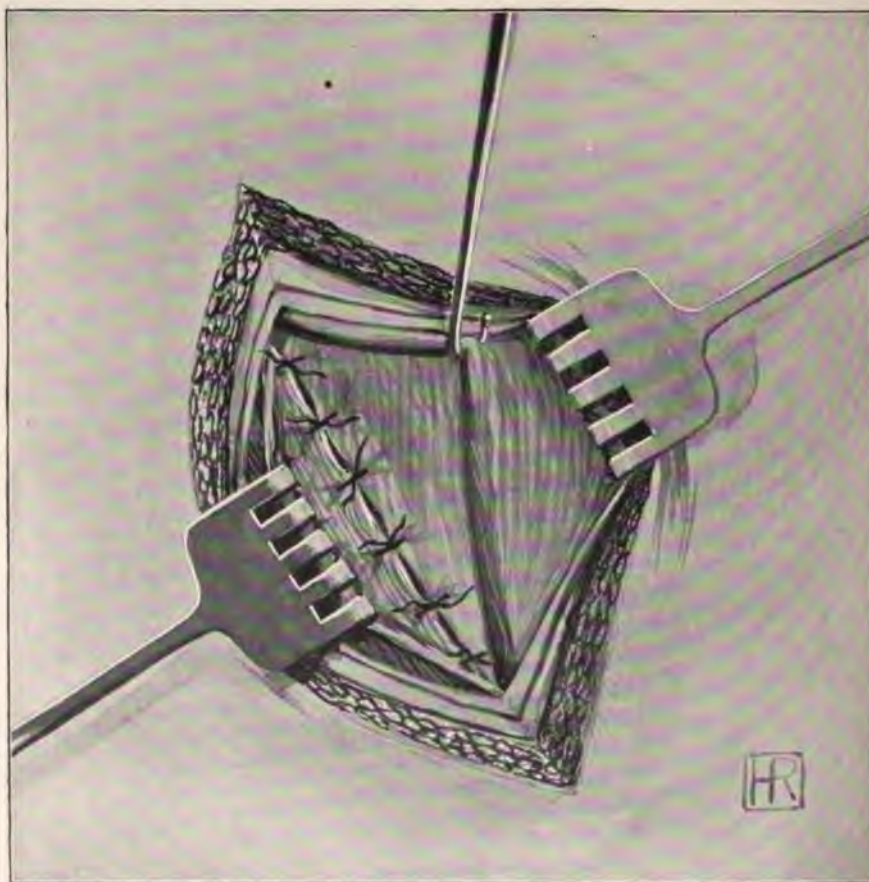


FIG. 130. — Deep sutures tied, forming new posterior wall for the inguinal canal.

Strangulated Femoral Hernia. — The general principles are here the same as those which govern the treatment of inguinal hernia. Having exposed the neck of the sac, the constriction should be relieved by incising upward. The radical cure of femoral hernia

is not as satisfactory as that of the inguinal variety. The femoral vessels are thoroughly exposed by dissection, after the sac has been ligated and returned to the abdominal cavity, and Poupart's ligament is stitched to the pectineal fascia by chromic gut sutures. In making this dissection, fat and lymph-nodes should be removed from the neighborhood of the femoral ring.

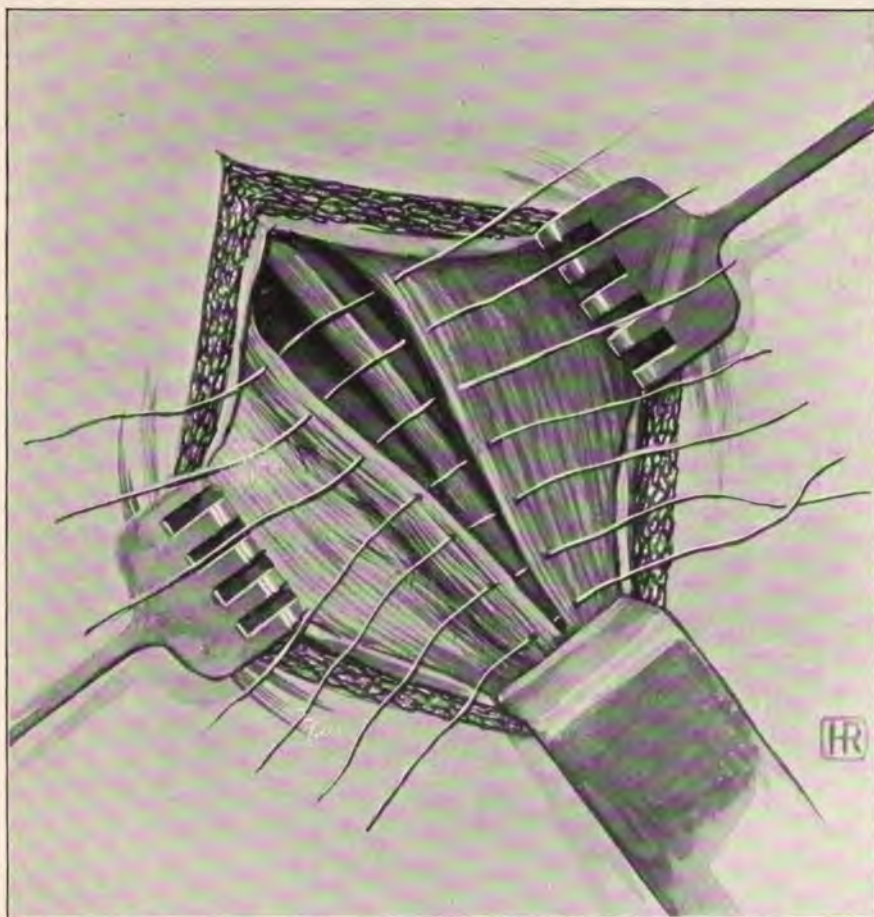


FIG. 131.—Cord lying on wall formed by deep sutures. Superficial sutures pass through the edge of the aponeurosis and the edge of Poupart's ligament. Note where the ligament is drawn in by the deep sutures.

Other Forms of Hernia should be treated on general surgical principles. Certain direct inguinal herniæ permit of operation similar to that recommended for the oblique inguinal variety. (Page 283.)

After-Treatment. — When the operation for strangulated hernia has been successful, there is an immediate remission of the symptoms. The vomiting ceases, and the patient rests quietly. For twenty-four hours fluid diet should be sparingly given. The bowels need not be moved for forty-eight hours, provided all is going well, and the wound need not be inspected for four days. Convalescence is usually uneventful; but the patient should not be allowed to sit up for at least three weeks, while in cases where the hernia was particularly large, the time of rest in bed must be prolonged to four weeks or more.

Persistent vomiting is of evil significance, and, if unchecked for twenty-four hours, needs most careful investigation. The wound should be dressed in order to ascertain whether protrusion and strangulation of the abdominal viscera may have occurred. The urine must be measured and examined. The stomach should be the last organ to be suspected, though it is, undoubtedly, sometimes at fault.

After recovery from the radical operation for inguinal hernia, where healing was by first intention, no truss or bandage need be worn. Where there was suppuration, a support will be necessary, but no hard pad should be allowed to press upon a recent cicatrix.

Most patients who have been operated upon for femoral or umbilical hernia should be advised to wear a support.

CHAPTER XVI

ACUTE DIFFUSE PERITONITIS

THE more frequent causes of this disease are, first, the introduction of septic material into the peritoneal cavity from without by traumatism; second, infection by the perforation of a viscus from disease; third, infection spreading from gangrene of an intra-abdominal organ without perforation; fourth, as a phenomenon in the course of an acute general infection without the perforation or necrosis of a viscus. Acute peritonitis from the last cause should not, in the present state of our knowledge, be treated surgically.

The disease occurs in various types as to virulency and the distribution of the infection. There may be no appreciable increase of the normal peritoneal fluid, or there may be quantities of serum, sero-pus, or pus either unconfined by adhesions, or in the form of abscesses walled off from the remainder of the cavity. There may also be a combination of these conditions, abscesses and collections of serous or sero-purulent fluid, coexisting with free abdominal fluid. Free fluid gravitates to the most dependent recesses of the abdomen, namely, the flanks and the pelvis.

The fluid, whether serum or pus, may or may not contain bacteria. It may or may not be of a foul odor. When several collections coexist, bacteria may be found in some and not in others. Lymph-coagula, of variable consistency, may lie free in the abdomen, or may be more or less firmly adherent to the visceral peritoneum, forming the adhesions which bind together the coils of intestine or omentum.

Early in the disease the vessels of the intestinal wall are visibly engorged, giving an appearance of injection, which later becomes cyanosis. In the majority of cases paresis and great distention appear, though this is not an invariable symptom, some of the most septic cases being associated with flaccidity, or even actual contraction of the intestinal walls.

Diagnosis. — The phenomena of the disorder vary considerably with the virulence of the sepsis.

Fulminant Peritonitis is rapidly fatal, the symptoms being those of acute septicæmia with abdominal tension and pain, great thirst, a dry tongue, anxious face, obstipation, rapidly developing icterus, high temperature, costal respiration, rapid, wiry pulse soon becoming weak and compressible, vomiting, somnolence, collapse, and death.

The More Usual Form of Acute Peritonitis begins rather suddenly with abdominal pain, often localized at the point of entrance of the infection, as, for example, the right iliac region when perforation of the appendix occurs, or the epigastrium when the infection enters where a gastric ulcer has invaded the peritoneum. After the onset the pain diminishes, and there is a deceptive feeling of relief, accompanied by steady acceleration of the pulse-rate. Soon there is nausea and the vomiting of ingested material, followed, again, by a sense of relief. Belching, hiccoughing, and the regurgitation of fluid are common. The vomiting is repeated at greater or less intervals, until it becomes quite frequent, greenish or brownish vomitus being ejected in considerable quantities even when little or nothing has been taken by mouth. The ejected matter consists partly of intestinal secretion and partly of fluid transuded from the gastric wall. Peristalsis seems to have been reversed. Later it will be noted that the gastric discharge is foul-smelling and fecal in character. From the very beginning of the attack, it will be observed that there is rigidity of the abdominal muscles, and that even when there are remissions of pain this rigidity persists. Distention of the intestines by gas comes on gradually, increasing

in the same ratio as the vomiting. This distention, often most marked in the epigastrium, first affects the stomach and several coils of the small intestine. It is a progressive symptom, although there may be remissions after vomiting or lavage, until at last general tympanites is present, with cyanosis and great distress in breathing, because of interference with the circulatory and respiratory functions. Failure of respiration and circulation is not, however, due entirely to the distention, but must in part be ascribed to general weakening of the vital forces by the action of septic products.

Obstipation is a prominent symptom of peritonitis of this kind, though it is not invariably present, even when there is considerable distention.

As in acute sepsis of any variety, there is congestion of the spleen, the liver, and the kidneys. The urine becomes scanty, high-colored, and albuminous. The sediment contains casts of the granular variety, often stained a brownish or yellowish color.

The patient is extremely restless, and though he may sink into an occasional fitful doze, true, restful sleep is almost or quite absent.

Delirium is common. It is not usually, however, of the violent type, and toward the end it gives place to stupor.

From the beginning of the attack, the patient looks prostrated and ill. In the effort to relieve intra-abdominal tension the thighs are often flexed. The breathing is of the costal variety. The pulse is rapid and often irregular, and it becomes gradually more compressible. Icterus appears and emaciation is rapid, the entire facial expression changing. The nose becomes pinched, the eyes sunken. The true Hippocratic expression is present at the last.

The disease is of variable duration, the average time before the fatal termination being from three to five days. During this period there are, naturally, more or less marked remissions, but on the whole the disease is pretty steadily progressive. Signs of actual improvement are the cessation of vomiting and belching,

the ability to take and retain food, the passing of stool and flatus, the increase in the quantity of urine voided, and the disappearance of the tympanites. One of the first signs of improvement is the changed countenance. This is very difficult to describe, but the expression seems to be restful and contented in character, in great contrast to the watchful, anxious, suffering look which is so remarkable as to form one of the features of the disease.

Asthenic Form. — Acute diffuse peritonitis is not, invariably, the violent, sthenic disease which has just been described. It sometimes takes quite a different form, none the less fatal for the absence of the classic acute symptoms which are commonly so marked. Instead, we have a low, typhoid condition, with little or no elevation of the temperature, or, indeed, with the thermometer registering a subnormal degree. Vomiting may or may not be present. There is no distention, but often a marked collapse of the abdomen. The face is dusky or cyanosed, the nose and extremities cold, and the pulse slow or rapid, but small and very compressible. The general vital condition is extremely low. There is abdominal pain frequently localized in character, and the usual rigidity is present though not always well marked. The sepsis is profound, and the patients usually succumb after a shorter period than do those afflicted with the commoner forms of the disease. Often very large collections of pus are found, especially in the pelvis. Adhesions are few and easily broken down, though occasionally such cases are met in which they are firm and numerous.

Bile Peritonitis will follow the effusion of biliary secretions into the peritoneal cavity. If the bile is aseptic, the peritonitis is not necessary fatal; but if it is mixed with pus, as in the case of ruptured empyema of the gall-bladder, the prognosis becomes exceedingly grave, though not necessarily hopeless.

Operation for Acute Diffuse Peritonitis. — General anæsthesia will in every case be necessary. There should be two trained assistants and a lay assistant, besides the anæsthetist. The instru-

ments are two scalpels, one having a narrow, sharp-pointed blade, eight artery-forceps, large, sharp retractors, large and small blunt retractors, two mousetooth-forceps, one or two pairs of scissors, six or eight sponge-holders, needles, a needle-holder, ligatures, sutures, dressings, and a stomach tube. If there is belching, hic-coughing, or vomiting, the stomach should be washed out before beginning to anæsthetize. If the patient cannot void urine, he should be catheterized. The location of the primary incision will depend upon the supposed site of the infecting focus. Thus, when, because of the history and the physical signs, it seems probable that the vermiform appendix is responsible for the peritonitis, the first incision should be made over this organ (Fig. 91); while if it is suspected that a gastric ulcer has perforated, the median line should be selected. Our effort should be to do away with the cause of the peritonitis, by actually removing the offending organ (*e.g.*, the appendix), or by freely opening and draining it (*e.g.*, the gangrenous gall-bladder), or by suturing to prevent the further leakage of septic material into the peritoneal cavity, as in cases of perforation of the stomach or intestine.

Where the operation is performed early in the disease, or when the process is a fulminant one, it may be that no changes sufficiently gross to permit of the actual surgical treatment of the peritonitis are found; so when the supposed cause of the trouble has been remedied, the surgeon has done all which is in his power. The wound, even in the absence of pus, must not be closed by suture, but should be packed and dressed wet.

When there is free fluid in the abdominal cavity, without adhesions, it will run out at the wound, but the pelvis will be found to be full when the other spaces seem to have emptied themselves. This fluid must be soaked up with sponges or holders, dipped into the cavity in rapid succession until they return dry. A gauze wick, wrapped in gutta-percha tissue, so as to form a cylinder, about as thick as a slender cigar, should be inserted, one end resting in the pelvis, and the other protruding from the

abdominal incision, where it should be cut off flush. One or two other wicks, more slender than the first, should be led down to points of obvious infection, and the viscera having been covered with a pad of gauze, the superficial portion of the wound may be packed and dressed without suture. The gauze pad, which is in contact with the viscera, must be so large that its edges extend beneath the parietal peritoneum for about half an inch all round, as an additional safeguard against protrusion.

When there is free fluid, serous or purulent, besides collections of fluid walled off from each other, the original infecting region, having been cleansed as well as possible by wiping, should be temporarily stuffed with gauze. Adhesions should be broken down, and each collection of pus, or other fluid, evacuated and the walls of the cavity wiped as dry as possible. The pelvis should be explored, and if fluid is present, cleansed as above described. The temporary packings should be removed, and cigarette drains having been led into the principal cavities, the wound may be superficially packed and dressed. If it is not possible to explore every part of the abdominal cavity through the original incision, another opening should be made, in such a place as will render all regions easily accessible. At the first sign of actual collapse, free stimulation is the proper treatment, and if the response is not quick and satisfactory, the operation should be stopped.

If there is great distention of the intestines, and obstipation has existed, the distended coils should be incised at points opposite the mesentery, dragging each loop out of the abdomen, and protecting the rest of the wound from contamination with the help of gauze packings. This part of the operation may be facilitated by turning the patient somewhat upon his side, and holding a pus basin, covered with a sterile towel, so that the intestinal contents shall run into it. In opening the gut, the narrow-bladed knife is used, and the openings should not be more than an eighth of an inch in length, running parallel with the axis of the intestine. The coil which is being manipulated should be care-

fully held in place, so that it may not slip back into the abdomen before the opening shall have been sutured. Each incision should be closed with three or four fine silk stitches, and after testing the water-tight quality of the little suture line by gently "milking" the intestine toward it from both sides, and ascertaining that no leak exists, this coil may be returned into the abdomen, and the next distended loop treated in a similar manner. It sometimes happens that, having plunged the narrow knife into the intestinal lumen, no fluid escapes, on account of the pouting of the mucous membrane into the wound. If the scalpel or a flat probe held in the wound is turned at right angles to it so as to separate its edges, the coil will rapidly empty itself. A sufficient number of incisions should be made to relieve the tension in a large portion or in all of the intestine, leaving it quite flaccid. The color of the intestinal wall will be found to improve at once, and if the case has not gone too far, contractions will occur on irritating or bluntly pinching the bowel, showing that true paresis is absent.

When septic material seems to be spread throughout the abdominal cavity, as, for example, when there has been rupture of a portion of the intestine with the escape of large quantities of the contents in every direction, the entire cavity may be flushed out with warm saline solution, poured from a pitcher. In these cases it is well to leave a considerable quantity of the fluid in the abdomen, and to elevate the foot of the bed after the operation. This is done in order to dilute the septic material, and hasten absorption by the diaphragmatic portion of the peritoneum. The flushing out of the peritoneal cavity is not advised as a routine method of procedure, where it is probable that all portions are not equally soiled, because of the danger of carrying the infection to healthy regions.

Whenever it is necessary to remove the intestines temporarily from the abdomen, the coils should be wrapped in towels wet with warm saline solution. It is of importance that the serous coating of the viscera should not be permitted to dry. Tension upon the mesentery or other attachments must be avoided.

If much coagulated lymph adheres to the intestinal wall, it should be gently removed with the fingers, whenever it is thought to be infectious or to cover points of infection. Such lymph-coatings are usually detached without difficulty, but when adhesion is so firm that there is danger of abrading or tearing the serous coat of the viscera, the coagula had better be left undisturbed. Rents in the visceral peritoneum should be closed by interrupted suture, using silk and a fine needle.

When there are no adhesions, but much infectious fluid within the peritoneal cavity, the case must be treated according to the patient's probable ability to endure manipulation of the viscera. If the general condition is good, it is advisable to remove the small intestine from the abdomen, incising it when necessary, in order to relieve tension. The entire abdomen is then to be cleansed as well as possible by wiping, not forgetting to explore the cavity of the lesser omentum. The median incision is best suited to this procedure. Collapse should be the signal to stop the operation, for it is better that the patient should die of sepsis afterward than that he should succumb to shock on the table.

It must be remembered that anatomically there is no way to distinguish the virulent from the mild form of diffuse peritonitis. A seeming slight serous inflammation may be intensely virulent, killing the patient in a short time; while a diffuse purulent case may end in recovery after comparatively little surgical interference. The mere absence of limiting adhesions should not be considered cause to regard the inflammation as a general one. The danger in any given case depends upon the virulence of the infecting germs and the capacity for resistance in the individual attacked. The clinical picture of the sepsis is a far more valuable guide in determining the true condition of the patient than the pathological appearances at the time of operation.

After-Treatment.— There will be considerable pain immediately after the operation, and opiates may be demanded for relief. Within twelve hours, unless the patient is doing remarkably well,

steps should be taken to secure an evacuation of the bowels. The cessation of nausea, when the patient was vomiting steadily before the operation, is one of the best signs that the condition has been relieved, and shows that there need be no haste to secure an action; while the continuation of the nausea and vomiting or belching means that there must be no delay in our effort to excite normal peristalsis. Having washed out the stomach, calomel, in divided doses, amounting in all to three or four grains, should be given. If this is retained, it may be followed by the citrate of magnesia in doses of one ounce every twenty minutes, until six or eight ounces have been taken, or the sulphate of magnesia in drachm doses every half-hour up to two or three ounces. If gas is passed by the rectum, it indicates that there is probably no intestinal obstruction and no paresis. An enema of warm peppermint-water will often be of use in relieving distention by gas, while an enema of the sulphate of magnesia, thrown high into the bowel, will aid in re-establishing peristalsis. The rectal tube passed into the distended colon often opens the way for the escape of the pent-up gas, to the great relief of the patient. The outer end of the tube should be held under water so that the escape of bubbles may be easily noted.

Digitalis, alternating with strophanthus and given soon after the calomel, will act not only as a cardiac stimulant, but as a diuretic as well. The tincture of digitalis may be given in doses of five minims every four hours, and the tincture of strophanthus in the same manner, so that one stimulant shall be administered every two hours. If there is nausea, these drugs may be given hypodermically. When the pulse becomes very weak and rapid strychnine sulphate is indicated. This drug, too, is given hypodermically, the thirtieth of a grain at a time, but not more frequently than every three hours. Meantime, if collapse seems imminent, whiskey or brandy may be injected freely with the hypodermic syringe.

Nutritive enemata are necessary when vomiting forbids nourishment by the mouth. (Page 205.) If the patient is able to take

food naturally, milk and lime-water, half and half, is well borne if given in doses of one drachm at a time every ten minutes, gradually increasing the quantity at each dose. During the time that the cathartics are being administered, food should be suspended. If there is diarrhœa, or if the odor of the vomited matter indicates the occurrence of fermentation, barley-water may be used for a time instead of the milk. Sometimes, when vomiting is persistent and annoying, a copious draught of hot water will be found of value. If it is vomited, it acts as a lavage; while if it passes the pylorus, it "settles the stomach."

If the tongue is dry, the mouth should be rinsed at frequent intervals, and when the patient is able, he should be encouraged to chew gum or soft paraffine, for the purpose of exciting the flow of saliva.

The temperature is not usually so excessive as to require special efforts to effect its reduction. Sponge baths or cold packs are often useful, and are well borne by the patient. When there is high fever with delirium, an ice bag should be placed at the head.

Should distention become an annoying or even a dangerous symptom, a tense coil of intestine may be opened at the wound, and if the flow of gas and feces warrants, allowed to remain open for the time. Irrigations may be practised through this intestinal wound.

During the entire time frequent careful examinations should be made, in order to ascertain, if possible, the existence of secondary abscesses in the peritoneal cavity or elsewhere. These are often difficult to find, even on painstaking palpation, until they have assumed considerable proportions. Tenderness on manipulation is the first objective sign of value, and it should lead to further examination which may disclose œdema or even deep fluctuation. When a secondary focus is suspected, poulticing the doubtful region for a day or two, or even for a few hours, will often hasten the suppuration so as to enable one to make a positive diagnosis and incise the abscess much earlier than would have been possible without this form of treatment. When abdominal palpation fails

to reveal anything suspicious, it must not be forgotten that rectal and vaginal exploration are often more successful. Abscesses of this kind (secondary) should be drained by rather stiff-walled tubes instead of by gauze or gutta-percha tissue, and they should be irrigated once or even twice a day. If drainage does not seem satisfactory, the possibility of counter-openings should be considered. Exploration of the cavity, with one finger in the rectum or vagina and a probe in the abscess cavity, may throw light upon the subject, and show the best path for the drain.

There is usually a considerable quantity of discharge for the first day or two after the operation, and this may be regarded as a favorable indication. The outer dressings should be changed when necessary, but the wound itself need not be inspected until forty-eight hours or more after the operation, when the drainage wicks should be removed and replaced by thinner ones, the shorter wicks being left out altogether. The gauze pad covering the viscera must remain for a day or two longer. When this has been removed the wound is merely packed in the usual fashion and dressed wet. When granulation has set in, the fasciæ may be united with a few chromic gut sutures so as to prevent the viscera from prolapsing into the wound. There will be some suppuration around these sutures, but since they soften rather slowly they will, in spite of this, accomplish the purpose for which they were intended. The skin should not be sutured, and there must be room for the passage of the drainage wicks or tubes left between the stitches in the fasciæ. This operation is painless, and does not usually require the employment of anæsthesia, either local or general.

After recovery from diffuse peritonitis, the patient should be kept under surveillance for several months, for it not infrequently happens that secondary abscesses occur some time after the convalescence seems to have been complete. The patient or his friends should also be told of the possibility of late complications from adhesions. A supporting belt or binder ought to be worn for at least a year.

CHAPTER XVII

THE RECTUM AND ANUS

Congenital Absence of the Anus (Imperforate Anus). — When a child is born without an anal aperture and with no outlet from the rectum into the bladder or vagina, the condition may be recognized by inspection, by the absence of abnormal discharge from the urethra or vagina, and by the rapid onset of the signs of intestinal obstruction. If there is a distinct bulging in the perineum when the child strains or cries, the probability is that a simple incision into the mass will relieve the condition. No anæsthetic will be required, and an assistant to hold the child's legs and one to help at the wound will be all that are necessary. The instruments are a scalpel, a pair of scissors, a pair of small, sharp retractors, two mousetooth-forceps, two or three artery-forceps, a needle-holder, needles, sutures, ligatures, and sponges. The child should be laid upon its abdomen so that its lower extremities hang over the edge of the table (Fig. 132), and after gentle disinfection of the skin, an incision should be made in the perineum, parallel and continuous with the intergluteal fold. Having exposed the bulging rectum, it should be drawn into the wound with mousetooth-forceps and incised, first packing gauze around the proposed opening and between the skin and the rectum in the subcutaneous space so as to avoid soiling by the meconium. The lower bowel should now be irrigated with warm saline solution, and a few sutures of silk should approximate the skin and mucous membrane. A very light packing of gauze in the rectum will complete the operation. The dressing should consist of a dry, clean, absorbent pad which must be

changed as often as necessary. Healing, in the absence of severe infection, will be practically complete in from six to eight days.

If there is no mass in the perineum to indicate the presence of a rectum, and if incision does not disclose the bulging, bluish tumor, it is best not to make too thorough a search at this time, but to perform left colostomy (see pages 223-229), which will give



FIG. 132.—Patient lying upon his abdomen with cushion under the hypogastrium. For operations about the rectum. In this position the speculum may be used to advantage.

an exit to the discharges until the child is strong enough to endure a more radical operation. Full anæsthesia is required under these circumstances.

Wounds of the Rectum.—Accidental wounds are commonly due to falls in the sitting posture upon some sharp object. The rectal wall in children has, in rare instances, been perforated by the careless use of a hard-rubber syringe tip. There is pain and tenesmus, with or without the immediate appearance of blood at the anus. If a considerable vessel has been injured, the rectal pouch may fill with blood before external hemorrhage appears.

The patient will then pass a large quantity of dark coagula and may rapidly become dangerously exsanguinated. If the injury has involved the urethra, there will probably be difficulty in micturition, and the appearance of bloody urine. Wounds of the bladder through the rectum, besides giving vesical symptoms, will probably be associated with appearance of blood and urine at the anus. If the vagina has been torn, symptoms will point pretty plainly to the fact, and the most superficial examination, after hearing the history of the injury, must make the condition clear. When the peritoneal cavity has been entered by way of the rectum, there may be prolapse of intestine into the rectum or even through the anus.

The history of an injury to the rectum should always be the signal for a most careful examination, not only of the bowel itself but of the neighboring organs. Beyond mere digital exploration, general anæsthesia is desirable, and, since operative treatment may be necessary, it will be as well to have everything in readiness. For digital exploration without anæsthesia, the patient should take the knee-elbow position or, if he is weak or decrepit, he may lie upon his side with the thighs and knees well flexed, the anal region being placed well over the edge of the bed or table. The exploring finger should be well lubricated, and the patient should make a slight expulsive effort to relax the sphincter and thus diminish pain.

If there is prolapse of intestine or other organs, there should be no effort at reduction until all is ready for operating. No enema should precede the anæsthetization.

Three assistants in addition to the anæsthetist will be required. The instruments for abdominal section and a speculum as well should be ready. A vaginal speculum will do if no rectal one is at hand.

After urination or catheterization the patient should be fully anæsthetized and then placed in the lithotomy position, the legs being held by two of the assistants, while the third is at the opera-

tor's right to assist at the wound. Introducing the well-lubricated thumbs back to back into the anus, the sphincter should be firmly but slowly stretched until it is paralyzed. In the male, the thumbs should be able to touch the ischial tuberosities with ease, but in the female, owing to the greater width of the pelvis, this may not be possible without dangerous tearing. Numerous little fissures will appear as a result of the stretching, but they do no harm. In the male, it is not well to stretch antero-posteriorly, but only from side to side. The entire procedure occupies about five minutes, and when it is finished the anus should *easily* admit two fingers.

If there is no prolapse of the viscera, the rectal wound should be inspected and explored with the finger and with a large-buttoned probe. If the vaginal speculum is to be used, the patient must now be placed in Sims's position or upon his abdomen with a pillow under the hypogastrium. (Fig. 132.)

Wounds communicating with the bladder or with the urethra must be repaired by suture, if possible. The rectum should be previously well scrubbed with soap and a sponge, and before the operation a sponge tied to a stout ligature and lubricated with vaseline should be pushed into the bowel above the wound so as to prevent the soiling of the field of operation. The ligature protruding at the anus will facilitate removal of the sponge. The wound itself should be disinfected as well as possible, and the ragged edges somewhat smoothed with scissors. Two layers of sutures are necessary, the first of catgut through the bladder or urethra only, and the second of silk through the rectal wall only. The plugging sponge is now withdrawn, and a layer of gauze placed against the line of suture. In all operations about the rectum, where there is danger of hemorrhage, a tampon-tube should be put in, and kept in place for forty-eight hours. This consists of a piece of rubber tubing wrapped with gauze and well lubricated, the whole being about half or two-thirds of an inch in diameter. The outer extremity is transfixed with a safety-pin, in order to prevent the accidental slipping of the contrivance into

the rectum. This tube, while it exerts the pressure of a packing, is patent, so that it does not act as a plug, but allows the gas and fluid discharges to escape. One of its great advantages is that it permits the flow of blood from the rectum, so that with the tampon-tube in place dangerous hemorrhage can remain unnoticed only through carelessness.

A catheter should be tied in for the first forty-eight hours, or for a longer time if its presence is unirritating. Urinary antiseptics, such, for example, as urotropine, fifteen grains once a day, or the oil of wintergreen in five-drop doses every four hours, may prevent the occurrence of cystitis.

Where neighboring organs have been injured through the rectum and suture has been performed, the bowels should be kept confined for from five to ten days; unless, indeed, there is leakage and it is clear that the operation will prove a failure. When it is desired to move the bowels after so long a period, a saline purge may be given in the morning, and at the same time, six ounces of *warm* olive-oil (or cottonseed-oil) injected into the rectum and retained. When, from two to six hours later, the patient feels as if his bowels would move, an enema of soap-suds will aid the passage and prevent the necessity for straining. After each evacuation of the bowels, a water enema should be given for the purpose of cleansing the rectum.

If, on examination, a wound is found toward the back or into the ischio-rectal tissues, it should, unless it is of very great extent, be plugged with gauze and not sutured. Large rents may be partly closed by suture, but plenty of space for drainage by gauze must be left.

When prolapsed intestine or other viscera are discovered in the rectum, the parts must be cleansed with the greatest care, and then preparation to open the abdomen in the median line should be made. Abdominal section is necessary in order to ascertain whether a portion of the organ, originally prolapsed, may have slipped back into the peritoneal cavity, and also in order to draw the remainder back

into place. A gauze plug should be placed in the opening in the rectum, and a large cigarette-drain of gauze and gutta-percha tissue left in the abdominal wound down to the infected viscera. When possible, the soiled organs should be brought near the wound in the abdomen, so as to permit of the use of a shorter drainage wick. (See for abdominal technique Chapters XI., XII., XIII., XIV., XVI.)

Unless peritonitis is already present, the patient should be kept under the influence of opium for at least twenty-four hours after the operation. The bowels should not be permitted to move until twenty-four hours after the gauze plug has been removed from the rectal wound, so that a tough lymph-barrier will have had time to form, preventing the entrance of feces into the abdomen.

Foreign Bodies in the Rectum. — These may have come from within or from without. Sharp fragments of undigested food, such, for example, as bits of bone, may become engaged in the folds or crypts of the rectal mucous membrane, in such a manner as to cause pain and ulceration. They will probably be found on digital examination without anæsthesia, but if there is difficulty in removing them, either from their size or location, general anæsthesia should be employed, the anal sphincter stretched, and the patient placed in an approximation to the knee-chest position. A speculum, a tubular vaginal instrument will do, should then be inserted, when the air will distend the rectum and permit of exploration by sight with the aid of a head-reflector. The foreign body, if seen, may be grasped with forceps and withdrawn.

The treatment in the case of objects introduced purposely or by accident from without, is the same as that just described, with modification, according to the size and shape of the body.

Ischio-Rectal Abscess. — Suppuration in the ischio-rectal fossæ may be a consequence of traumatism from without or from infection from an inflamed hemorrhoid, fissure, or furuncle. These abscesses often attain considerable proportions, the pus burrowing with little resistance in the soft, fatty tissue of this region. The disease begins with an induration which is sometimes difficult to

detect. As the mass increases in size, there are the usual constitutional symptoms, accompanied by a deep throbbing pain. When the abscess becomes very large, urination may be interfered with on account of pressure upon the urethra. There is a tendency to perforation into the bowel, although later other openings through the skin may also occur.

Treatment.—Incision into the indurated mass before the occurrence of fluctuation will give the most satisfactory results. General anæsthesia is necessary if the work is to be done with thoroughness, and there should be three assistants, distributed as described on page 308.

When it is impossible to secure the services of so many persons, the patient may be held in position with the help of an improvised crutch, as shown in Fig. 133. The instruments are a scalpel, a pair of scissors, a pair of small or medium-sized sharp retractors, a mouse-tooth-forceps, a dressing-forceps, six artery-forceps, one or two sharp spoons, a probe, a speculum, sponges, ligatures, and dressings. An irrigating bag or bottle will be found of use.

The sphincter should be stretched (see page 309) and although the patient has been prepared for the operation by catharsis and at least two enemata, it will be found best to push a good-sized lubricated sponge, with ligature attached, high into the rectum. (Page 309.) A radial incision should now be made, beginning near the anus as a centre, and extending through the induration. The



FIG. 133.—Improvised crutch, made by bandaging a padded board to the patient's knees. The position is seemingly faulty, for the reason that both legs have not been bandaged. A bandage from the shoulders to the middle of the board will flex the thighs on the abdomen. Before the operation the patient must be moved to the middle of the table.

abscess thus entered should be evacuated with the help of the irrigator, scraping away the sloughs with a sharp spoon. Spurting vessels must be caught and ligated, while the lips of the wound are held apart with sharp retractors. On exploring the cavity, with one finger in the bowel and the other in the wound, the thickness of the tissue between the abscess and the rectum will be determined. If, as is usually the case, the wall of the rectum alone separates the two cavities, it is probable that a communication actually exists, and that drainage will be most complete if the original incision is carried directly through the sphincter into the rectum. If, on exploration, it is found that the abscess connects with another collection of pus, in the opposite ischio-rectal fossa, a counter-opening must be made, but it should not be carried through the sphincter. Having drawn out the rectum-plugging sponge, the wounds should be tightly packed with gauze, and a tampon-tube placed in the anus. A T-bandage over a thick pad of gauze completes the dressing.

After-Treatment. — An opiate to allay the post-operative pain will be necessary. Later, morphine or opium may be demanded, in order to check a tendency to premature movement of the bowels. Twelve hours after the operation, the superficial dressing should be removed and replaced by a wet one. If the case progresses favorably, the bowels need not be moved for three days, when, after a saline purge, enemata should be given as described above. (Page 310.) Daily evacuations must be secured by the use of mild laxatives combined with enemata, if necessary, the movements



FIG. 134. — The vertical line shows the incision for external urethrotomy; the curved line that for prostatic abscess. The two lower radiating lines are for ischio-rectal abscess.

always being followed by a cleansing injection of clear water. Catheterization may be required until the tampon-tube and the packings have been removed. When the packings are renewed, they should be much lighter than the original ones, since there is little or no danger of serious hemorrhage in this region after the third day. Solid food may be taken after the bowels have moved. There will always be a certain degree of temporary incontinence following division of the sphincter ani, but permanent trouble of this kind is rare, unless the muscle has been cut through at more than one point.

Thrombosed Hemorrhoids.— This condition may be recognized by the appearance at the anus of one or more bluish, exquisitely sensitive, hemorrhoidal tumors, which either cannot be replaced or which may be returned with great difficulty, and without relief. If treated expectantly, the inflammation may gradually subside, leaving a nodule with more or less temporary induration; or suppuration may occur. Great relief, if the tumors are few and small, will follow incision and the turning out of the septic clot, the wound being packed with orthoform gauze. The orthoform should not be used as a daily dressing, for fear of a dermatitis. With a very keen scalpel this little operation is not particularly painful, and the relief is immediate. When the hemorrhoidal masses are numerous or large, a more extensive operation is demanded, after the regular preparation of the patient, and with the help of general narcosis.

Operation.— The assistants and the instruments are as enumerated under the heading of ischio-rectal abscess, with the addition of a stout needle-holder, large needles and strong silk, or chromicized gut. Having stretched and paralyzed the sphincter, one of the posterior tumors should be seized with mousetooth-forceps, in order to steady it, and the integument and mucous membrane at its base incised all around. If the hemorrhoidal mass is a very large one, it will be safer to divide it into two or more portions, treating each portion as a separate tumor. Passing the needle, armed with a ligature of stout silk or chromicized gut, through the tumor, entering and emerging in the line of the incision, the ligature

is to be cut just behind the needle's eye. The pedicle of the tumor will then be found transfixed by two ligatures of equal length. These should be crossed and firmly tied, the tumor being then cut away with the knife or with scissors. The same procedure should then be employed for the removal of the other hemorrhoids in turn, and the operation is finished. No more skin than is absolutely necessary should be sacrificed. A small tampon-tube is put into the anus, and the usual dressing adjusted. The after-treatment is on the same lines as that following the operation for ischio-rectal abscess. The ligatures will come away of themselves. (This operation is not recommended for cases of hemorrhoidal disease without thrombosis.)

CHAPTER XVIII

THE MALE GENITAL ORGANS AND THE URINARY SYSTEM

Congenital Phimosis. — This deformity requires operative treatment when the opening of the prepuce is so small that there is decided difficulty in micturition or even total inability to pass urine. The indication is for the immediate widening of the



FIG. 135. — Operation for congenital phimosis. Scissors cutting with one blade within the prepuce, the other without.

orifice. No anæsthetic is required. The child's legs should be firmly held by an assistant, and an effort made to introduce a fine probe into the opening, passing the instrument between the prepuce and glans penis, so as to loosen adhesions. The anterior or dorsal preputial layer may now be cut through with fine scissors, one blade of which is passed into the opening, carefully avoiding the urethra itself. (Fig. 135.) The prepuce should be divided as far back as the corona, and the entire glans exposed by bluntly dissecting away the mucous layer of the foreskin. No sutures will be required and usually no ligatures. Should the foreskin be very redundant, it may now be shortened by ablating with the scissors, while the membrane is kept upon the stretch by an assistant who holds it at both angles. (Fig. 136.) The part

around the frenum contains vessels which may spurt, and demand ligation. No sutures are required, and the only dressing necessary is a roll of absorbent gauze dusted with a mild aseptic powder. The dressing will naturally soon be soaked with urine, but as long

as there is no congestion of the glans, and no foulness about the parts, nothing need be disturbed for two days, when a wet dressing should be applied over the gauze for a few hours, so as to soak it, and facilitate its removal. A dressing of zinc oxide ointment, or some similar bland salve, may now be used, changing it twice daily. There is always some swelling of the prepuce after the operation, but it need rarely cause any change in the treatment, unless there is cyanosis of the glans or foreskin, when the band of gauze must be loosened, and the parts covered with a wet dressing of normal salt solution.



FIG. 136. — Clipping of redundant preputial tissue.

Inflammatory Phimosis. — This is sometimes due to the presence of ulcerations within the preputial sac. In order to treat the primary local cause of the trouble, the prepuce should be slit dorsally, as just described. If it is deemed wise to remove any part of the foreskin, a very few silk sutures may be put in to prevent too great a gaping of the edges of the wound. Beta-eucaine, without an elastic constrictor, will suffice as an anæsthetic, except in extraordinarily nervous individuals, when narcosis will be required. The instruments are sharp, strong, straight scissors, four artery-forceps, two mousetooth-forceps, a needle-holder, needles, suture, ligatures, dressings, and sponges. If general anæsthesia is decided upon, a bloodless operation may be performed with the aid of an elastic constrictor, — a method which is inadvisable with many anæsthetic drugs which are subcutaneously injected.

Paraphimosis. — This condition is due to the drawing back, past the glans, of a prepuce, the opening of which is too small to permit of easy reposition. When the usual methods of reduction have failed, and the swelling has become so great as to be alarming, or when the glans is so constricted that it has become dusky or mottled, threatening gangrene, a dorsal incision, through the

constricting tissues down to the body of the penis, should at once be made. Primary ether anæsthesia, or the injection of a few minims of the cocaine or eucaine solution along the line of the proposed incision, will enable one to perform this little operation without pain. No suturing is necessary. The parts should be well covered with a warm, wet dressing, in order to restore the circulation as quickly as possible.

Phagedenic Ulceration of the Penis. — Acute ulcerative processes sometimes spread with such rapidity in this region, that the most radical measures are necessary to prevent the destruction of the organ. Such ulcerations are best treated by thorough disinfection, with the actual cautery under general anæsthesia, if the area infected is at all extensive. The metal point, at a dull red heat, should be made to enter all the crevices and folds of the diseased part, and every suspicious spot well seared. The first dressing should be dry, and may even consist of a desiccating powder lightly covered with gauze; but in twenty-four or forty-eight hours this had better be discarded for the wet dressing, which is then continued until the wounds are granulating. During the healing process, the parts must be carefully and frequently inspected, and if any portion of the surface seems to be infected, it should be at once touched with the cautery.

Bubo. — Acute suppuration of the inguinal or femoral lymph-nodes occurs, usually, through infection of the genitals; but the presence of inflammation about the anus, the thighs, or even the toes may also prove the starting-point of the trouble. Ingrown toe-nails are not infrequently to blame for femoral bubo. The disease generally begins with a feeling of stiffness in the inguinal fold. Pain becomes rapidly worse, and intumescence marked and progressive. Redness begins with a faint, erythematous blush, which is almost pathognomonic of the presence of pus. There is usually considerable constitutional disturbance, with chills and elevation of temperature.

As soon as the diagnosis of acute suppurative inguinal or femo-

ral adenitis is made, the case becomes one for operation. A wet dressing or a poultice may, however, be advised, if a delay of a few hours is unavoidable. General anæsthesia should be employed, for the operation is apt to prove a very painful one. The necessary instruments are a scalpel, sharp, medium-sized retractors, small blunt retractors, scissors, six artery-forceps, a dressing-forceps, a sharp spoon, needles and a needle-holder, besides ligatures, dressings, sponges, etc.

The region should be shaved and scrubbed as described in Chapter III. If the mass of glands seems to be freely movable, it may be dissected out as a whole; but this is an operation requiring great care and considerable skill, for there will be pretty free hemorrhage from the infiltrated tissues, and in order to do the work thoroughly it is necessary to lay bare the femoral vessels, where they emerge from the ring. The resulting wound may be partly closed by suture, but it must be drained by tube, or by a gauze strip.

If the affected mass seems to be pretty firmly fixed by periglandular infiltration, and considerable destruction of tissue has already taken place, it is hardly worth while to dissect away the nodes. Instead, a free incision into the bubo may be made, followed by a thorough removal of as much diseased tissue as possible with the sharp spoon. The wound must then be packed with gauze and dressed wet. This scraping operation will usually be followed by the separation of more diseased tissue and after that, prompt healing. It sometimes happens, however, that the acute infection has been grafted upon a more chronic one, such, for example, as syphilis or tuberculosis. Some enlargement of the remaining glands will then persist, or the wound may refuse to heal completely. If the disease is amenable to treatment by internal medication, the cure may be continued in this way, but if not, another operation, looking to the radical excision of all infected tissues, must be undertaken. As a general rule, it is wise to test anti-syphilitic treatment pretty thoroughly, and if this is not successful, to proceed to the removal of the disease by excision.

Impassable Urethral Stricture with Retention of Urine.— This condition is a very grave one, and it demands the best efforts of the surgeon for its immediate relief. If there is hemorrhage from the urethra, due to instrumentation, the operation is all the more urgently indicated, while if urinary infiltration, with or without sepsis, complicates the case, delay of but a few hours may take away all chance of recovery.

Strictures of this nature usually have their seat in some portion of the deep urethra, and should be attacked by the perineal route. This is the rule, even when strictures in the anterior urethra are known to exist.

It is best to have four assistants at this operation, two of whom, the anæsthetist and chief assistant, should be medical men, while the other two, whose place it will be to hold the legs of the patient, may be laymen. If the case is urgent, and assistants are not to be had, the patient may be held in position by an improvised apparatus made with bandages and a piece of wood, as shown in the illustration. (Fig. 133.)

The instruments required are a set of steel sounds, a scalpel, a blunt bistoury, a pair of medium-sized sharp retractors, at least half a dozen artery-forceps, two mousetooth-forceps, one or two pairs of scissors, a probe, a grooved director, a dressing-forceps, a needle-holder, several short hemostatic needles, a large rubber catheter or drainage-tube, ligatures and sutures, and an irrigating syringe or a good, large hand syringe. Sponges and dressings must not be forgotten.

The patient being in position (Figs. 133 and 134), the perineum, the anal region, and the neighboring parts of the thighs should be scrubbed, shaved, and disinfected. A sound of such size as will pass to the seat of stricture may be introduced, and held steadily in the median line by a trustworthy assistant. If a tight stricture exists in the anterior part of the urethra, the previous introduction of the sound will, necessarily, be omitted, a small, soft instrument being used in its place; or if this anterior narrowing is also impassa-

ble, it will be necessary to operate without a guiding instrument. The latter is a rare condition. A few days after the perineal section, when the urethra has had functional rest, it is frequently possible to introduce a guide through this anterior stricture, when it may be dealt with as is then seen fit; or after the urethra has been opened in the perineum, it may be found possible to pass an instrument from behind forward. It is essential that the patient should

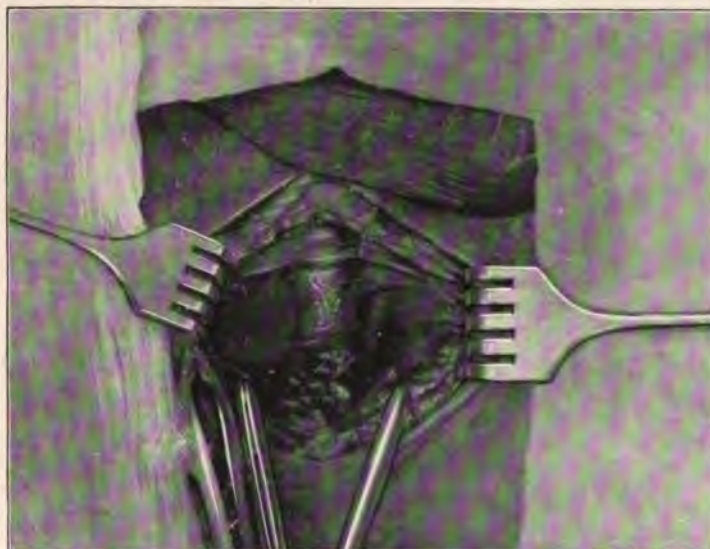


FIG. 137.—External perineal urethrotomy. The sound distends the urethra, here in great part covered by the bulb. (The scrotum is allowed to hang merely to show its location.)

lie squarely on his back, and that the sound or other guide be kept as nearly as possible in the median line.

The chief assistant should sit at the operator's right. With the scalpel, an incision of three to three and a half inches should be made along the median raphe from the lower portion of the scrotum, which the holder of the right leg should keep well up out of the way, to a point about three-quarters of an inch from the anus. (Fig. 134, the vertical line.) During the entire operation, care must be taken to keep the dissection well in the median line,

and the surgeon should assure himself from time to time that the assistants are supporting the patient in position and that the wound retraction is evenly made. Having exposed the bulb (Fig. 137), this structure should be drawn up out of the way with a blunt retractor, loosening the bulb from the urethra by blunt dissection. The urethra should then be incised in front of the stricture. A



FIG. 138.—The bulb is drawn upward by the blunt retractor and the sound is seen in the opened urethra, the lips of the wound in the canal being held apart by threads.

silk suture or a bulldog-forceps placed in each lip of the urethral wound will act as a retractor. (Fig. 138.) In a deep wound it is not always an easy matter to hold the tissues in this way, so it may be necessary to separate the edges of the urethral wound with the same sharp retractors which hold the other structures. The sound may now be removed, and the urethral incision carefully carried through the strictured portion, as much cicatricial tissue

as practicable being excised. All bleeding vessels which spurt should be secured by ligature. If the bulb has been accidentally injured and is bleeding, a packing of gauze under the blunt retractor should be held upon the injured place during the operation, and a packing carefully laid over the spot when the work is finished. Having cut through the stricture, a catheter or a drainage-tube may be pushed into the bladder, and the viscus washed out. The insertion of the drain must be done with the greatest delicacy, and always with the aid of sight, for the tube, forceps, or director might easily be pushed for a considerable distance into the lax tissues beside the urethra. Success depends upon the operator's ability to recognize the continuation of the urethral mucous membrane into the strictured portion. The stricture should be divided so as to admit a full-sized sound, say from 28 to 32 of the French scale. The tube may be left in place for twenty-four hours, and the entire wound packed with gauze in such a manner that the tube emerges from the centre of the packings. A longer piece of tubing must be attached to the intravesical one and carried out to a vessel over the side of the bed, so that the patient may remain dry. A rather bulky mass of loose gauze and a T-bandage completes the first dressing. A careful watch should be kept over the patient for the first twenty-four hours following perineal section, for it is sometimes followed by troublesome or even dangerous hemorrhage, due to the slipping of a ligature caused by some movement of the patient. If such recurrent hemorrhage should be encountered, the packings must be removed at once, and the bleeding point sought and secured. It is a good plan to tie all arteries with the greatest care at the time of the operation, and to assure one's self, before placing the packings, that hemostasis is perfect. Thin catgut, if it is but strong enough, is less liable to slip than thick.

Retrograde Catheterization with Suprapubic Cystotomy.—It is sometimes impossible, in spite of the greatest care, to follow out the urethra from the perineum. Rather than submit the patient to an unnecessarily long anæsthesia, it is well in these cases to open the

full bladder from above by suprapubic section, and then to pass a sound or a thick probe along the finger as it palpates in the bladder the internal orifice of the urethra, and so out through the perineal wound. It may be necessary to cut from without upon the end of this sound or probe where it presents itself in the perineum, provided the strictured passage cannot be followed. To perform this operation the patient should be placed in the dorsal extended position, or with the pelvis elevated on an inclined chair (Fig. 139), and after the shaving and the disinfection of the pubic and hypogastric regions, an incision of about three inches should be made in the median line. The lower end of



FIG. 139. — Pelvis elevated with the help of a chair. Position of especial value in aseptic operations about the bladder and other pelvic organs. Not to be recommended when there is a collection of pus in the pelvis.

this incision hugs the pubes. The rectus muscles should be strongly retracted, and when the space beneath is reached, a little blunt scraping from below upward with the handle of the knife will push the peritoneal reflection away, and the anterior wall of the distended bladder will come into view. Should the peritoneum be accidentally wounded, the operation must not proceed

until this opening has been closed by suture. Two moderately thick silk sutures should now be placed deep in the vesical wall, one to the right and the other to the left, to serve as retractors. (Figs. 141, 142.) An incision made between these sutures while they are drawn upward will open the bladder. (Fig. 142.) When the operation has been finished, if the patient seems to be in good condition, the vesical wound may be closed by suture through the bladder wall, turning the mucous membrane in but not penetrating it with the needle. The other structures, skin and muscle, should not be sutured, but simply covered with a dry dressing. If, for

purposes of drainage, or because of the poor state of the patient, it is determined to leave the vesical wound open, a large rubber drainage-tube should be kept in the bladder for five or six days, while the wound through the skin and muscles is well packed, in order to avoid the infiltration of urine into the prevesical space. The tube within the bladder should be connected with the side of a tube from an irrigator-bottle or bag, the flow of which is regulated so that a constant siphonage takes place from the bladder and the patient remains dry. (Fig. 143.) The retracting sutures in the bladder wall should be left in place for a few days, in case it becomes desirable or necessary to inspect the viscus.

Three days after the perineal section, the passing of sounds must be commenced, and continued every

second or third day until the perineal wound is closed, when the periods between the soundings may be gradually lengthened until the instrument is passed but once a month. This should be con-

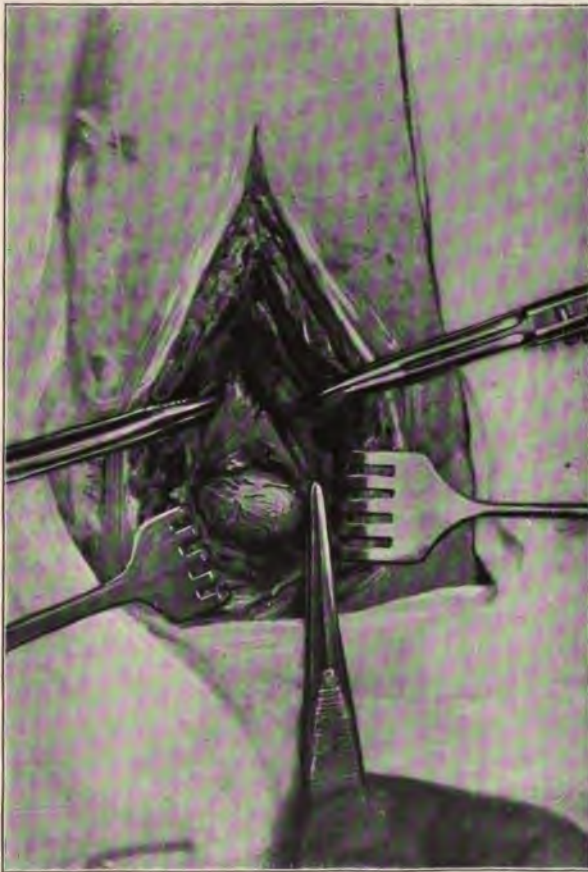


FIG. 140. — Suprapubic cystotomy. The distended bladder is seen below. It is partly covered by the reflection of the peritoneum.

tinued for about six months, when the interval may be further extended, but after such operations it is well to examine the urethra at least once a year.

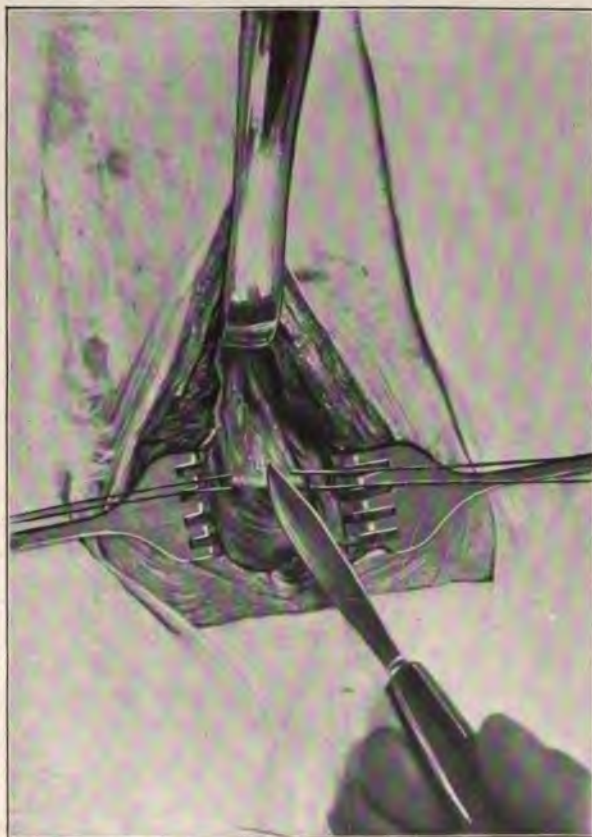


FIG. 141. — Peritoneal fold raised up by blunt retractor. Retracting sutures in the bladder wall raise a fold of the viscus which is about to be incised.

Foreign Bodies in the Urethra. — These may come from within or from without. Those most frequently met with are vesical or renal calculi, which, though small enough to enter the canal, become impacted or caught at some fold or narrowing. There is always more or less pain according to the portion of the urethra involved. Thus, in the deep urethra, a foreign body will cause perineal pain and soreness and a straining sensation, while in the anterior portion the pain and tenderness to manipulation

will be more marked, while there will be less reflex straining. There is apt to be considerable swelling and some mucosanguinolent discharge. Occasionally there may be retention of urine. The foreign body should be removed as soon as possible, because there is a tendency toward a slipping backward into the bladder. Usually its exact location can be made out by palpation

from without, but if this fails, a steel sound, well lubricated and passed slowly in without anæsthesia will be stopped at the foreign body, or will cause such severe pain as to indicate its location. If careful manipulation does not cause the object to advance toward the meatus, the attempt may be made to grasp it with an instrument, the best kind for this purpose being that known as the alligator - forceps. (Fig. 11.) If the attempt with the forceps is not immediately successful, it is unwise to make persistent efforts, for fear of injuring the urethra. The object should then be removed through a median longitudinal incision, which may afterward be sutured in two or three layers, no suture being permitted to enter the lumen of the canal. This incision must be made in the perineum or in the penile urethra, according to the location of the foreign body; but if it is possible to move the object so that the bulb need not be incised, severe hemorrhage may be avoided. After the incision and suture of the urethra a



FIG. 142. — The bladder has been opened. The blunt retractor now holds the bladder wall as well as the fold of peritoneum. The thread retractors expose the interior of the viscus.



FIG. 143. — Siphonage of bladder through suprapubic wound. The artery-forceps partly occludes the tube from the irrigator so that the flow is regulated. Pressing the tube in the pail allows the bladder to fill with fluid from the irrigator. (This method of drainage is applicable to large abscess cavities as well as to the bladder.)

small, soft catheter should be tied in for four or five days, during which time the canal should be irrigated with normal salt solution several times a day. The catheter must be removed on the appearance of irritation. If the object has slipped into the bladder in spite of our precautions, it may be removed through a suprapubic wound (see page 324), and the vesical opening at once closed by suture, while the other tissues are allowed to granulate. The skin incision may, however, be closed with the help of adhesive strips or even by secondary suture. The opening in the bladder in cases of this kind need not be a large one, an inch or an inch and a half being usually sufficient. The external abdominal wound, however, will vary in size, according to the thickness of the tissue to be divided.

Objects introduced from without are occasionally seen. Pieces of catheter, accidentally broken off, may be removed with forceps or brought to the meatus by manipulation far easier than can be done in the case of calculi. Pins or similar objects are sometimes inserted voluntarily, and slip in beyond the reach of the patient. If a pin has gone in head first, as is usually the case, a

smart push will drive its point out through the floor of the urethra (Fig. 144), and by drawing the pin out as far as it will come, it can be turned and then pushed back, this time with the head toward the meatus, where it is not difficult to secure and

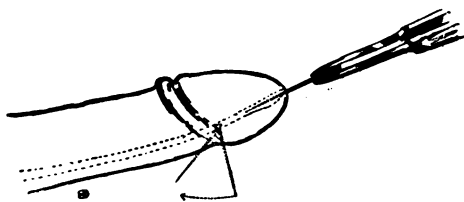


FIG. 145. — Extraction of pin from urethra. Second and third steps.

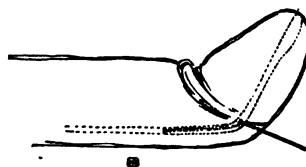


FIG. 144. — Pin in the urethra. Illustration of method of extraction. First step.

withdraw it. (Fig. 145.) Other objects may have to be dealt with in different ways, but the principle to be observed is that it is more dangerous to make rough manipulations in efforts at extraction than to extract through an incision.

Rupture of the Urethra. — This accident, while not of common occurrence, is so serious in its nature that it requires the most careful attention. An apparently slight injury may result in periurethral inflammation, with a fatal issue. Rupture of the pendulous portion of the canal is exceedingly rare, and is nearly always the result of direct violence applied to the erect penis. It is not accompanied by great pain, but there is some hemorrhage from the meatus, and, unless the injury is a very slight one, some swelling at the seat of the rupture. If the appearance of a large hematoma, with perhaps retention of urine, indicates a considerable tear in the urethra, it is best to cut down upon the place at once, for the purpose of evacuating the clot, which is almost sure to become septic, and suturing the tear in the urethra. (See page 327.) If the injury is apparently slight and urination unimpeded, expectant treatment, with the internal administration of urotropine, oil of gaultheria, or salol, is all that is needed. But it must be remembered that infection, even where the actual traumatism is slight, may be a serious complication. Its occurrence calls for immediate incision and drainage. Sounding is necessary during the healing process, and at regular intervals afterward, because traumatic strictures are very unyielding when once they have formed.

Rupture of the perineal urethra is usually caused by a fall astride a narrow object, or by a kick or other sharp blow upon the perineum. Fractures of the pelvis are sometimes complicated by tearing or rupture of the urethra. The accident is generally to be recognized by the appearance of a swelling in the perineum, together with blood in the urine when passed voluntarily or when drawn by catheter. If blood appears at the meatus on manipulation of the perineal tumor, it is certain that the urethra has been damaged. If blood appears at the meatus, but the urine drawn by catheter is perfectly clear, it means that the injury is in front of the compressor urethræ muscle. If efforts at urination are made when there is a tear in the posterior urethra, it is very likely that, whether urine is voided or not, there will be some extravasation. This

urine will, in all probability, cause phlegmon, so that under all circumstances operative procedure is the only proper course when the diagnosis of rupture of the posterior urethra has been established, and the sooner this operation is performed the better. Perineal section (see page 320), with an attempt at suture or partial suture of the injured urethral canal, and a packing of the cavity formed by the hemorrhage or extravasation of urine, is the proper form of treatment. If performed before the occurrence of infection, the prognosis is good. Stricture is commoner after transverse wounds of the urethra than after longitudinal ones.

Periurethral Abscess.— The usual cause of this condition is the closure, through inflammatory swelling, of the orifice of an infected urethral gland or follicle. It is recognized by the appearance of a painful and sensitive tumor somewhere along the course of the urethra, but most commonly along the anterior part of the canal. Later constitutional symptoms occur with reddening and fluctuation in the affected locality, and sometimes considerable hindrance to the passage of the urine. These abscesses should be drained as early as possible, so that simultaneous opening both inward and outward may be prevented. If this accident should occur, it is probable that a troublesome fistula will result. The patient should be warned in any event that such a fistula may form, but he may be told that with early and thorough incision the chances for recovery without this deformity are best. The operation may be undertaken with local anæsthesia, if the abscess is small or if it is about the pendulous portion of the urethra; but if it is behind the scrotum, unless it is very insignificant in size, narcosis should be employed and perineal urethrotomy (page 320) performed at the same time. A free incision into the mass must be made, and as much as possible of the necrotic tissue removed with the scalpel and the sharp spoon. Wounds of this kind should be kept moist, until all the little sloughing shreds have come away, when a dry dressing will be found to hasten the healing. The granulations may be further stimulated by touching them occasionally with

the solid nitrate of silver stick, and this should be employed especially in those cases where there is reason to fear the formation of a urinary fistula. If the abscess was a rather large one, with considerable destruction of tissue, the occurrence of stricture must be guarded against by the frequent passing of sounds.

Prostatic Abscess.— This form of infection is usually accompanied by severe constitutional symptoms, due to septic absorption; while the pain and discomfort referred to the local condition are not correspondingly great. After the acute onset of the prostatic inflammation, there may be, with the formation of pus, a distinct remission in the local symptoms, while the chills, high temperature, and prostration which indicate the gravity of the disease are often wrongly ascribed to some other cause. Examination of the rectum will generally disclose a fluctuating mass, tense or not according as the pus has remained imprisoned in the prostate body itself or has perforated the capsule and invaded the surrounding cellular tissue. Occasionally these abscesses burrow deeply and threaten the life of the patient. Not infrequently they rupture into the rectum and terminate with the formation of a recto-urethral fistula. The abscess requires treatment by operation as soon as the presence of pus is evident. The incision should be made in the perineum whether the abscess has already burst into the rectum or not, for not only is the drainage in this region more complete, but permanent fistulæ into the rectum will thus be often avoided.

Operation.— When operating for prostatic abscess a horseshoe-shaped transverse perineal incision (Fig. 134) is to be preferred to the median longitudinal or sagittal one. General anæsthesia is necessary. The assistants and instruments are the same as those enumerated on page 320 in speaking of perineal section, with the addition of an aspirating syringe with long needles. Having placed the patient in the lithotomy position, with the assistants arranged as described on pages 320 and 321, a crescentic incision about three inches in length should be made an inch or an inch and a quarter from the anus, with that aperture between

the horns of the crescent and below its central portion. The lower lip of this incision will tend by contraction toward a straight transverse line, while the upper lip will become slightly more convex, so that the wound itself gapes and allows plenty of room for further dissection. Cutting through the muscles in the floor of the perineum, one can at last easily separate the rectum from the anterior structures with the aid of blunt dissection. The finger in the wound will now feel the prostate or the infiltrated tissues around it, and aspiration with a needle will show how deeply the pus is situated. Having ascertained that the needle is in the abscess cavity, a grooved director may be inserted alongside, and on the director a slender dressing-forceps forced into the mass. Spreading and at the same time withdrawing the dressing-forceps, the abscess cavity is well opened and may be explored with the finger, curetted, and packed while the lips of the wound are held apart with retractors. It will probably be necessary to catheterize the patient for a day or two, until the first packings have been removed.

Urinary Infiltration.—Whenever, by reason of traumatism or the internal rupture of a periurethral abscess or perforation due to ulceration behind a tight stricture, a free opening exists between the urethral lumen and the surrounding cellular spaces, urine may find its way into the tissues outside the canal. This constitutes urinary infiltration. It is most common in the parts adjoining the posterior urethra. The diagnosis is made by the appearance of a tumor, usually in the perineum, which rapidly increases in size until, if unchecked, an area involving the perineum, the scrotum, the subcutaneous tissue of the penis, the inner part of the thighs, and the lower part of the abdominal wall is tense with the infiltrating fluid. The parts affected by the extravasation will, to a certain extent, vary with the location of the leak; thus, if the opening is behind the triangular ligament, the posterior tissues will be first filled up; while if it is in front, the scrotum and penis will become swollen before the deeper regions. If the urine is sterile, symptoms of sepsis will be considerably delayed, while if it is decomposed,

sepsis occurs from the beginning. Any urinary infiltration will, however, become infected after a time, and therefore the condition demands immediate surgical intervention. In addition to treating the cause of the trouble, the infiltrated tissues should be freely incised in a sufficient number of places, and each incision packed or otherwise drained. General narcosis is necessary. Whatever the cause of the infiltration, a perineal opening of the urethra is advisable (page 320), and, having finished this step of the operation, counter-incisions as in the case of phlegmon should be made. (Page 92.) Very large soaking wet dressings should be applied, and the patient well stimulated and fed. In short, all the means at our command must be used to enable the patient to successfully combat the constitutional poison. (See Chapter V.)

The dressings require changing at least once a day, and oftener if the discharge is free. The prognosis in cases of this kind varies with the degree of sepsis.

Suppurative Epididymitis and Funiculitis. — Suppuration in the course of an acute epididymitis is, fortunately, a rare complication. It may be suspected when the acute attack becomes chronic, and when one or more nodes which have been painful through the course of the disease become soft and semi-fluctuant without decreasing in size. There seems to be a tendency for such nodes to become adherent to the skin. The patient does not regain his usual strength and has some elevation of temperature, generally toward evening. There may be nodes of a similar character, too, along the course of the spermatic cord (funiculitis). Under general anæsthesia a free incision should be made in the scrotum and the abscesses carefully opened, each one being curetted and plugged with gauze. The opening in the scrotum need not be sutured. If it is allowed to granulate, the resulting scar will not be as large as one might expect, and the drainage will be more complete. The wound requires wet dressings until granulation is well under way.

Suppurative Orchitis of the acute variety may be the result of infection after traumatism, or it may come on as the result of dis-

ease. It is recognized by tense swelling of the testicle with œdema of the skin accompanied by fever. It demands treatment by incision and packing. Multiple abscess is the usual form of suppuration in this organ. Exuberant granulations springing up during the healing process may require occasional scraping with the sharp spoon. The patient must be told that atrophy of the testicle is apt to follow.

Twist of the Cord. — This accident is a rare one, but it is very important to recognize it early if anything is to be done to save the testicle. The symptoms begin suddenly, during violent exercise, with acute sickening pain, much like that of acute epididymitis. Swelling and tenderness on manipulation are noted, but there is only slight elevation of temperature, if any. If the accident is suspected and the patient is seen within a few hours, the testis should be carefully rotated so as to untwist the cord. If twisting in one direction causes pain, the effect of rotation in the opposite way should be tried. If the manipulation tends to cause reduction of the torsion, there is immediate relief. If untwisting cannot be effected in this manner, incision is the only proper treatment, and for this operation it is best to employ general anæsthesia. Two assistants, an anæsthetist and one other, are required. A generous opening should be made into the scrotum, laying bare the testicle and cord. On incising the tunica vaginalis, sanguinolent fluid will escape, and the testis will be found highly congested and of a deep bluish-red color or almost black. Unless the organ is very obviously alive and the circulation is shortly reëstablished, after reducing the twist, it is best to castrate. Before proceeding, however, it is wise to assure one's self that the other testicle is present and in a normal condition. Having decided to remove the diseased organ, the cord should be well exposed and isolated, the vas deferens separated from the other funicular structures, and these transfixed with a hemostatic needle armed with strong catgut. The cord should be tied off in two sections, the vessels in its proximal end searched out and each one tied with a separate

ligature, beyond the mass ligatures, so that the danger in the event of slipping may be minimized. The vas may be divided without ligation, but its accompanying vessels must be tied. The testicle may now be drawn out of the wound and cut from its attachments. If the parietal layer of the tunica vaginalis shows a tendency to strip out easily, it may be removed together with the testicle. The scrotal wound is closed with fine silk and a dry aseptic dressing applied. A mass of elastic, loose gauze should be held in place by a firm and wide T-bandage. Five days later the sutures may be removed, and until this has been done the patient must not be permitted to get out of bed.

Retention of Urine from Enlarged Prostate. — In certain cases of this kind where an acute exacerbation has occurred, it is quite impossible to relieve the patient by catheterization. When instruments of various shapes and sizes have failed to enter the bladder, and when poisoning, septic or uremic, is feared, something must be done to effect prompt relief, or the patient will succumb. Aspiration of the bladder just above the pubes may then be performed. Great care should be taken that the needle used for this purpose is absolutely sterile, while the suprapubic region of the patient must be shaved, scrubbed, and otherwise disinfected. A very small incision through the skin should precede the aspiration, so that no precaution is omitted in regard to the carrying in of infectious material from the skin. If the relief does not cause relaxation of the parts, permitting catheterization, the aspiration may be repeated; but where, after several aspirations, one cannot catheterize, suprapubic cystotomy (see page 323) must be performed. The bladder wall usually remains congested for several days, and there is a considerable amount of bloody discharge, which gradually diminishes until the continual rest which the operation affords brings about a condition as nearly normal as possible under the circumstances. The advisability of removing the prostate body itself may then be considered.

Bladder: Wounds of the Vesical Wall. — The accidental wounding of the bladder wall may occur by reason of penetrating injuries,

or from fractures of the pelvis. Rupture may follow a blow over the full bladder. It has also been known to occur from a jarring fall upon the sacrum, without fracture, the bladder being full at the time. Perforating vesical wounds may be roughly divided into two classes; those which involve the peritoneal cavity, and those which do not. All serious injuries to the bladder are apt to be characterized by vesical tenesmus, and the appearance of more or less blood on attempts at urination, or on catheterization. If, from the location of the external wound, and the known course of its direction, together with the absence of shock or other grave symptoms, it is presumable that the bladder alone has been injured, and that the wound in no way involves the peritoneum, a simple enlarging of the opening is demanded in order to drain the bladder. This is best accomplished by a tube surrounded by gauze, arranged in such a manner that no urine shall escape and cause irritation or infection of the perivesical spaces. Indeed, if the patient is seen immediately after the occurrence of the injury, the wound in the bladder may even be sewn up with a fair probability that no leakage will take place. The skin, of course, should remain unsutured, with packings placed in the extra-vesical portion of the wound. Occasionally wounds of the bladder occur from behind or even through the rectum. Here suprapubic drainage, with an attempt at suture through the rectum, should be the procedure of choice. Suture of the rectal wound has been described in Chapter XVII. If the wound is a small one, a permanent catheter through the urethra into the bladder may suffice for drainage, but if it is large, or there is any reason to suppose that there may be an injury involving other parts of the bladder, it will be found safer to open the viscus by the suprapubic incision. The bladder in this case will not be distended, so additional care must be exercised in order to avoid injury to the peritoneum. A sound of fair size passed into the bladder through the urethra may be felt through the suprapubic wound, and will assist in identifying the vesical wall.

When the bladder wound extends into the abdominal cavity,

the case is much more grave. This accident is to be suspected from the location of the wound, the occurrence of vesical tenesmus, and the fact that the catheter draws pure blood or a scanty quantity of bloody urine. Abdominal section must then be performed without delay. The patient should be placed upon a table raised at the head, so that a minimal quantity of urine may come in contact with the intestines, while most of that which is extravasated remains in the pelvis. After wiping out as much free fluid as possible, the bladder wound should be closed by inverting the peritoneal covering into the bladder, and suturing through it, as well as through the vesical muscular wall, but not through the mucous membrane. The sutures should be so placed that peritoneal surfaces shall be in contact, since adhesions will then quickly form, and make leakage improbable. If the wound was a very small one, the bladder may be drained by catheter, but if it was large, or if there were more than one wound, a suprapubic drainage opening should be preferred. If sepsis, local or general is present, the abdominal wound should not be closed, but packed, and perineal drainage of the bladder practised. This is quite a simple matter, for it is but necessary to push a sound or other blunt instrument from within the bladder, by way of the wound, toward the perineum, so that its end can be felt or even seen bulging in the perineal region, and then to cut down upon the sound from without. A large catheter or a rubber drainage-tube may then be made fast to the sound, and drawn into the bladder through this perineal button-hole. This procedure is practically bloodless, and involves no additional shock. If the patient is a woman, it is best to tie in a large-sized catheter. A perineal opening is of course not required. When the catheter in the urethra is used as the sole drain, it should be remembered that the bladder must on no account be permitted to become distended, for at least seven days. In all cases of this kind, a good urinary antiseptic, such as urotropine or salol, should be administered by mouth, and little if any local washing or disinfection attempted.

Wounds of the Ureters. — These are of rare occurrence. They may be suspected when the direction of the wound is such that the ureter will naturally be in line with it, and when, in addition, there is blood in the urine, or when urine appears at the wound itself. Generally, when penetrating wounds of the ureter exist, there is serious injury to one or another of the large vessels, or of the peritoneum. The treatment in order to tide over the immediate emergency is abdominal section for the purpose of closing the peritoneal wound, if one exists. If none is found, the abdominal opening may be closed completely, but if a complicating peritoneal wound has been found, the peritoneum, at the point of injury, should be sutured, and a drain of gauze from this spot should be brought out at one of the angles of the laparotomy incision. The closure of the ureteral opening may be left for possible future operation. Not infrequently such wounds heal spontaneously, while in other instances there is fistula formation. Even the cases where the wound seems to have healed kindly, must, however, be carefully watched, since stricture and consequent hydronephrosis may result.

Injuries to the Kidney. — Contusions of the kidney may, when severe, require operative treatment. If after the infliction of blunt injury by a blow or by crushing force in the renal region, there is great shock with symptoms of concealed hemorrhage, or if there is a rapidly developing tumor or hematuria in addition to the shock, it is probable that the kidney has been severely injured. If the shock is prolonged, and the injury is known to have been inflicted by the application of great force, such as the passing of a heavy wheel over the body, abdominal section must not be too long delayed. The assistants and instruments are the same as those enumerated on page 191, in speaking of the preparation for abdominal section. A bone-forceps for rib resection may also be required. Full anæsthesia is indispensable. Incision in one of the semilunar lines will enable one to explore the kidney, and also to deal with any injury to adjacent organs. If rupture

of the kidney is suspected, the intra-peritoneal wound should be closed and drained by gauze packings, while the kidney itself is drained through a wound in the loin, exposing the organ. This incision should be made with the patient in the lateral position, lying over a thick pillow, so as to gain as much space as possible between the ribs and the crest of the ilium. (Fig. 146.) The incision may be parallel with the last rib and must be at least six inches long. Having cut through the lumbar fascia, the quadratus lumborum muscle comes into view. This must be held toward the back by strong retraction, while still more



FIG. 146. — Position and line of the wound for drainage or removal of the kidney. The dotted lines follow the ribs, spine, and iliac crest. The entire line of incision is not seen.

space may be gained by drawing the last rib upward with a sharp retractor. In a few cases, where there is but little space between the costal border and the iliac crest, it may be necessary to resect the twelfth rib. Another retractor in the lower lip of the wound allows of comparatively easy dissec-

tion between two mousetooth-forceps. Keeping well toward the back the peritoneum is avoided, and the fatty capsule being incised, the white perinephric fat pouts into the wound. The kidney may now be explored with the finger, and may even be drawn completely out of the wound for inspection. In the event of severe contusion, it will be well to incise the kidney itself, and then quickly pack it with gauze. If there has been a rupture of the organ, the packing without the incision is all that need be done. Should the renal vessels themselves be found irreparably injured, the entire kidney had better be removed. This is not a difficult matter after the

above procedures. When possible, it is best to secure the vessel separately, and to resect as much of the ureter as can be conveniently reached. If there is reason to hurry the operation, the vessels and ureter may be secured by a single stout ligature. The external wound may be sutured, but it is best to leave a space for drainage, at first by gauze, which in the event of suppuration must be replaced by a tube.

Penetrating wounds of the kidney may be recognized by the same symptoms as those of contusion of the organ, with the additional sign of the escape of urine from the wound. This is not, however, of constant occurrence, and it usually signifies that the pelvis of the kidney has been opened. If the wound is a small one and possibly aseptic, as in the case of gunshot injuries by the modern small-caliber bullets, it is best to wait at least a few hours for the occurrence of symptoms of sufficient gravity to warrant operative intervention, for many wounds of this nature heal nicely under ordinary aseptic dressings. In case there has been much hemorrhage into the bladder, intra-vesical clots may form, making it impossible to empty the bladder either voluntarily or by catheterization. If this causes the patient great distress, and there is reason to believe that the bladder contents may become septic, suprapubic cystotomy should be borne in mind as a possible last resort. Of course, irrigation with cool or tepid water through the catheter should be first performed, with hope of thus getting rid of the coagula.

Urinary fistulæ through kidney substance or through the renal pelvis tend to close spontaneously, but those through the kidney itself usually heal more speedily. In dressing wounds of this kind it is necessary to pay great attention to the surrounding skin, which easily becomes inflamed and excoriated from the constant soaking with the urine. The dressings should be frequently changed, and the skin kept anointed with some rather stiff ointment, such, for example, as zinc oxide combined with lanolin or diachylon ointment.

CHAPTER XIX

THE FEMALE GENERATIVE ORGANS

Hematoma of the Vulva. — Blunt traumatism is the usual cause of this condition. One of the labia majora is most commonly affected, because the lax tissue of this region permits of easy distention by the effused blood, forming, at times, a very considerable tumor. The diagnosis is easy, a swelling appearing within a few hours after some such injury as a kick, or a fall upon a hard, narrow object. Ecchymosis is slow to appear.

Treatment. — So long as there are no signs of infection, and no severe pain, gentle pressure by a pad of gauze under a T-bandage is the only treatment required besides rest in bed. At the slightest sign of local or general sepsis, or if the pain is severe or the swelling increasing, incision and drainage must be performed. General anæsthesia will be necessary, unless the patient is extraordinarily courageous, when the local injection of eucaine may be substituted. Two assistants besides the anæsthetist will be required, unless the legs of the patient are held in position by bandaging, when one assistant will be sufficient. (Fig. 133.) The instruments are a scalpel, a pair of sharp retractors, two artery-forceps, a sharp spoon, and a pair of scissors. Having anæsthetized the patient, she should be placed upon her back, the legs and thighs being flexed and raised upon the abdomen. After shaving and disinfecting the parts, a generous antero-posterior incision should be made over the most prominent part of the tumor, so that the septic clot may be easily removed with the help of the irrigator stream and the sharp spoon, the wound being meanwhile

thoroughly exposed with the sharp retractors. A firm gauze packing and a temporary dry absorbent dressing completes the operative work.

After-Treatment. — Twelve hours after the operation, a wet dressing should replace the original dry one. On the third day the packings may be removed, lighter ones applied, and the case further treated on general surgical principles.

Vulvo-Vaginal Abscess. — The commonest abscesses in this locality are those due to suppuration of one of the vulvo-vaginal glands. The frequent though not invariable cause is gonorrhœal infection. The diagnosis is made from the appearance of a fluctuating, painful, and throbbing tumor occupying the usual location of the gland toward the posterior part of the vulva, gradually extending anteriorly as it increases in size. The inguinal and sometimes the femoral lymph-nodes become enlarged and sensitive, and constitutional symptoms arise.

Treatment. — Incision and packing is the proper treatment. One assistant should be present. The instruments are a sharp-pointed scalpel or bistoury, a pair of small, sharp retractors, a mousetooth-forceps, a little carbolic acid, ninety-five per cent., and a little strong alcohol, ninety-five per cent. Having placed the patient upon her back with the legs raised as in the operation for vulvar hæmatoma, the mucous surface should be painted with a six per cent. solution of cocaine, and when this region has been thus superficially anæsthetized, a few drops of eucaine solution may be injected in the line of the proposed incision. The sharp, narrow bistoury may, in this instance, be employed, plunging it into the tumor and cutting outward, against the usual surgical rules. Holding the edges of the wound apart with small, sharp retractors, the lining membrane of the abscess, which is, practically, a suppurating cyst, should be wiped out with a little piece of sponge saturated with ninety-five per cent. carbolic acid, and held with forceps, taking care that none of the escharotic shall touch the skin or surrounding mucous membrane. In a few seconds the acid

should be thoroughly wiped away with pure alcohol, and a packing of gauze and a wet dressing applied. The packing may remain for three or four days, a lighter one then replacing it. If these abscesses show a tendency to recur, extirpation of the suppurating sac is advisable.

Phagedena of the Vulva.— This form of ulceration should be treated in the same manner as has been described in Chapter XVIII., when speaking of phagedena of the penis. The disease called *noma vulvæ* is a species of phagedena which occurs in poorly nourished children. Its progress is frightfully rapid unless checked by thorough cauterization under anæsthesia, the actual cautery being used. Attention to the general condition of the patient is of great importance.

Accidental Wounds of the Uterus.— These injuries are inflicted through the vagina, through the rectum, or through the abdominal wall. A not uncommon history is that of an attempt at self-performed abortion. The true history is rarely to be ascertained, and septic peritonitis may be the first indication of the condition. The treatment is then that outlined in Chapter XVI., together with curetting of the uterine cavity. (Page 345.) Perforation of the uterine wall from without is associated with more or less injury to other structures, such, for example, as the bladder and the intestines. The treatment should follow the principles discussed in Chapter XI., the uterus being emptied if pregnancy exists (see page 345), and in any case the rent closed by chromic gut suture. The uterine wall requires many deep, non-perforating sutures, in order that there may be no so-called “blind” spaces for the accumulation of discharge, inviting infection. A gauze wick should be placed in the lower angle of the abdominal opening, passing down to the line of suture.

Retention of Septic Matter within the Uterine Cavity.— By far the commonest cause of this condition is the infection of the ovum or some portion of it. This infection usually comes from without, and because of unskilled efforts to empty the uterus during the

pregnancy or at its termination. Examination by the vagina during or just before labor, without proper disinfection of the hands of the operator and the genitals of the patient, may be the cause of uterine sepsis. The diagnosis is made when symptoms of acute septic intoxication (Chapter V.) accompany uterine tenderness, a soft, patulous os, and a putrid discharge from the vagina. Almost invariably there is considerable enlargement of the uterus, usually depending upon the duration of the pregnancy. The character of the sepsis is in most instances violent, the temperature being high, the pulse rapid, and delirium early.

Treatment. — The only rational therapy is quickly and thoroughly to remove the septic uterine contents. This, to be done properly, demands the employment of general anæsthesia, at least two assistants being needed besides the anæsthetist. The instruments are a bivalve speculum or a pair of larger blunt retractors, a bullet-forceps, a uterine dilator, a uterine sound, or a long, thick probe, a long dressing-forceps, a dull curette and a sharp curette.



FIG. 147. — A bivalve speculum.

The vagina should be washed out by a douche of one per cent. lysol, which disinfects and at the same time lubricates. The patient should lie upon her back with the thighs and legs flexed, the buttocks being over the edge of the table, before which the operator sits. Having introduced the speculum, the sound or probe should be passed into the uterus, in order to learn with certainty the direction of the canal. If no bivalve speculum is at hand, a pair of blunt retractors may be used to draw the perineum back-

ward and the anterior tissues forward. An assistant manages each retractor, leaving both hands of the operator free. Seizing the anterior lip of the cervix with a bullet-forceps, the uterus is fixed while the dilator is being used. The blades of this instrument should be introduced so that the stretching may be done laterally. Dilation of the cervix must be performed slowly and intermittently, a few seconds of tension giving place to a similar period of rest, until the curette will easily enter the canal without a hitch. If the size of the foetus is considerable, it should be removed by manual effort after somewhat greater dilation of the os, the left hand on the abdominal walls pressing the uterus downward, while two fingers of the right hand force the os back over the presenting part in the vagina until the foetus can be seized. The curetting may now proceed. Holding the bullet-forceps with the left hand, the blunt curette should be inserted and each part of the uterine wall in turn systematically scraped, the instrument being seldom withdrawn. Sloughing tissue will begin to come away with contractions of the uterus in larger and smaller fragments and strips, which should be removed as they appear, with the aid of a stream of some bland solution from the irrigator the nozzle of which need not enter the vaginal orifice. Those which seem to adhere at some point within, while they protrude from the os, may be removed with the dressing-forceps. The soft feeling imparted to the operator through the contact of the curette with the tissue which is being removed gives place to a firmer, grating feeling as the sound portion of the uterine wall is reached. Blood now issues from the os, together with the shreds and masses which are being scraped away, but the hemorrhage is seldom profuse enough to cause alarm. If the work with the blunt curette seems inefficient in dislodging the more adherent tissue, the sharp instrument may be very cautiously used. When all portions of the uterine cavity have been explored, and the walls everywhere impart the firm sensation of healthy tissue to the operator, a slip of gauze should be carried with the long forceps or the uterine sound into

the organ, the free end of the packing being allowed to protrude from the vagina. An absorbent pad over the vulva and a T-bandage is the dressing.

After-Treatment. — Pain is seldom severe immediately after this operation, so anodynes are not commonly required. When, as is sometimes the case, uterine colic occurs, the gauze packing must be at once removed; but if this symptom does not supervene, the gauze may be permitted to remain for twenty-four hours, when it is drawn out and not replaced. Vaginal douches of one-half per cent. lysol solution should be ordered three times daily, and the general treatment of septic conditions carried out. (Chapter V.)

Pelvic Abscess. — By this term is meant those collections of pus in the female pelvis which are surrounded by adhesions with the neighboring tissues, whether the original pus-focus was in the tube, the ovary, or the pelvic cellular tissue. Collections of pus which are contained in non-adherent organs, although they are anatomically pelvic abscesses, will not be here considered. Pyosalpinx, in the case of a tube which is free from adhesions, should not be called a pelvic abscess; while a pus tube in a bed of adhesions with acute clinical signs of sepsis is a pelvic abscess, and often cannot be distinguished from other forms of suppuration in the pelvis.

Diagnosis of Acute Pelvic Abscess. — The early symptoms are local pain and tenderness with signs of acute septic poisoning. Palpation of the abdomen reveals a tumor-like resistance in the pelvis or toward the groin. Muscular rigidity is not well marked. Pain on complete extension of the thigh is noted in some cases where there is inflammation around the psoas or iliacus muscle. By vaginal examination the uterus will be found pushed over to one side and pretty firmly fixed by the exudate which feels at first indurated and later boggy or even fluctuant. When perforation through the vagina is imminent, a soft, crater-like area will be noted. Examination through the rectum should always be performed, for these collections of pus not infrequently empty themselves into the lower

bowel. The abscess is always tender on manipulation. If the diagnosis is plain, incision and drainage are demanded; but if there is doubt, treatment with poultices for one or two days will help materially to clear up the uncertainty. Chills, jaundice, high temperature, rapid or weak pulse, and other signs of severe sepsis should be indications that further delay in operative treatment is fraught with danger. Fluctuation, of course, whether in the vagina, rectum, or in the groin, indicates the necessity for immediate operation.

Operation by the Vaginal Route. — This is to be preferred in all cases in which there is no abdominal fluctuation and in which the source of suppuration is obscure. By this method the patients are in many instances cured, and in others relieved of the dangerous sepsis, permitting later treatment for the purpose of getting rid of the tube, ovary, or other offending organ which may have been at the bottom of the trouble. General anæsthesia is required. There should be one assistant besides the anæsthetist and those who hold the legs. The position is the dorsal one, with the legs flexed upon the abdomen. The instruments are a pair of vaginal retractors, a bullet-forceps, several sponge-holders, an aspirating syringe with a long needle, a long-bladed straight bistoury, a sharp spoon with flexible handle, or a small uterine curette, sharp-pointed long scissors, a dressing-forceps, and a grooved director. Before beginning to operate, the rectum should be examined digitally, in order to make sure of the position of the bowel with relation to the mass, and the bladder emptied voluntarily or by catheterization. Having introduced the perineal and the anterior retractors, which are held by the assistants who are supporting the patient's legs, the cervix should be seized with the bullet-forceps and held upward and forward out of the way. If there is a fluctuating point, it should be incised, provided it is in the posterior cul-de-sac, but not otherwise, as there is danger of wounding the ureter when incisions are made beside the cervix. If the fluctuating spot is at one side, or if there is no true fluctuation, but merely a boggy feel or even an elastic resistance, the long aspirating needle should

be pushed into the mass from a point just behind the cervix, and in such a direction as to avoid the bowel. A finger in the rectum at this time will assist in keeping the proper line. As a general rule, the needle should point toward the promontory of the sacrum. If aspiration reveals pus, the syringe should be removed, leaving the needle in place, and an antero-posterior incision through the vaginal mucous membrane made with the knife. Along the needle, a pair of sharp scissors, the blades closed, should be plunged into the abscess, and then removed with the blades separated, or at right angles to the incision, so as to tear a good-sized opening in the abscess wall. There will usually be a rush of pus, and the cavity empties itself. Irrigation with a stream of saline solution or even plain water will hasten the evacuation of the abscess, which should now be explored with the finger, the vaginal retractors being removed so as to facilitate the manipulation. Secondary cavities, if found in this way, should be broken into and evacuated, but great care must be taken that the peritoneal cavity be not accidentally entered through rough handling of the tissues. If the finger finds much sloughing material, gentle curetting of the walls may be permitted, but the ever present danger of perforation must not be overlooked. While the lips of the vaginal wound are separated with dressing-forceps, a long narrow strip of gauze should be carried into the opening, and the entire cavity packed. The vagina itself should be lightly filled with gauze, one end protruding, and a pad of gauze and a T-bandage applied as the outer dressing.

After-Treatment. — Morphine will probably be needed to quiet the post-operative pain. There may be a rather sharp rise of temperature, which usually recedes without treatment within the next twenty-four hours. The gauze should not be removed without reason for two or three days or even longer, when it will be found to have loosened from the abscess wall by the formation of pus, and will come away without pain. Unless there is a distinct tendency to the obliteration of the abscess cavity by the falling

together of its walls, a drainage-tube should be inserted for a few days, its free end protruding from the gauze-filled vagina. Irrigation through this tube may be practised, if the discharge is profuse.

Opening into the Rectum. — This should be done only when there is distinct evidence of pointing. The vaginal route being so much simpler and the after-treatment of the wound, here, being so satisfactory, it should, in most instances, have the preference. When a very thin wall separates the abscess cavity from the rectum, the fact may usually be ascertained by ordinary digital examination, which will disclose an œdematous condition of the mucous membrane, with a particularly soft dimple-like area where the pus is about to break through. Under general narcosis the anal sphincter should be stretched and the needle of the aspirator passed along the finger into the softened place. Pus having been demonstrated, the closed sharp-pointed scissors may be forced into the cavity along the track of the needle, and an opening made as described above. (Page 349.) If the pointing is low down near the anus, the operation is done with the assistance of sight, always the best way, by making use of the rectal speculum, or, putting the patient upon her abdomen in the prone position (page 307), the single-bladed vaginal speculum or retractor.

The drainage-tube in this location is troublesome, because it is very apt to become dislodged when the patient's bowels move. As a rule, it may be discarded in a few days. If the opening should heal too quickly, so that retention occurs, the abscess will open spontaneously through the cicatrix, but if this should happen repeatedly, more radical operative treatment will probably be necessary to effect a permanent cure.

Drainage by the Abdominal Route. — When induration occurs at or near the groin, together with symptoms of progressive sepsis and without the presence in the vagina of an easily accessible mass, operation from without should be selected as the simpler procedure. Unless the case is extremely urgent, it is well to apply a thick poultice for a day or two. If then the abscess becomes very

superficial, it may be incised and drained with the help of local anæsthesia; but if sepsis is pronounced, there should be no delay in relieving the condition.

General narcosis will be required when the induration is extensive, and in any event unless superficial fluctuation shows that the pus is very near the surface. At least two and preferably more assistants should be at hand, for it is impossible to know in these cases that we may not be forced to invade the free abdominal cavity. It is best to be prepared for all contingencies, so the instruments for abdominal section should be ready. (See Chapter XI., page 191.)

The incision is made well toward the outer side of the abdomen, just within Poupart's ligament, with which it should be parallel. If, in spite of all precautions, the peritoneal cavity is opened, temporary gauze packings should be put in so as to prevent effectually contamination, and the dissection continued. The proximity of the abscess may usually be suspected from the dense infiltration of the tissues, which should be divided carefully, making each incision shorter than the previous one, so that the wound becomes of a funnel shape. As soon as deep fluctuation can be made out, the aspirating syringe may be cautiously used. If nothing can be withdrawn with the syringe, the dissection should proceed with still greater care; but when once the clinical signs have demonstrated the existence of an abscess, a "dry tap" should not prevent thorough exploration by dissection. When the appearance of a bead of pus announces that the abscess has been entered, a grooved director or some other slender blunt instrument forced into the cavity will act as a guide for the dressing-forceps, which, having been inserted closed, may be withdrawn open. The pus is washed away with a stream from the irrigator, and the abscess walls explored with the finger. Sloughing tissue may be partly removed by rather gentle scraping with the sharp spoon, and the entire cavity then packed with gauze. The temporary abdominal packings should now be removed, the external wound packed, and a spica bandage applied to keep the dressing in place. Naturally, if there

is a strong tendency to prolapse of viscera from the accidental peritoneal opening, gauze will be required to hold them in place. As a rule, however, this is unnecessary, the superficial packings being all that are needed. After the first three days, the gauze may be removed from the abscess cavity, and a lighter packing substituted, or, if the cavity is very large, or its walls rigid, one or two drainage-tubes may replace the packing. (Fig. 57.) Intra-peritoneal packings must not be disturbed without reason for five or six days.

When a pelvic abscess has been long neglected, the pus may have burrowed toward the loin or through the femoral canal into the tissues of the thigh. Counter-openings should then be made by cutting down upon a large probe or some other blunt instrument which has been insinuated into the diverticulum through the wound. Tubes should be inserted through the counter-openings as soon as they are made, by tying them to the probe as it emerges under the knife. The withdrawal of the probe carries the tube into position. Transfixing safety-pins guard against the actual slipping away of these drainage-tubes. (Fig. 57.)

Convalescence is usually very rapid and satisfactory. If the final sinus closes slowly and the discharge is profuse, it is proper to suspect the existence of something which is acting as a foreign body; but if the discharge is slight, stimulation of the walls of the tract should be attempted by curettings, and by injections of eight per cent. chloride of zinc, or twenty per cent. carbolic acid dissolved in alcohol.

Ruptured Pyosalpinx. — A pus tube may rupture on account of force applied externally, or its walls may give way at one point either from great distention or from ulceration within the organ. Symptoms of shock, with subsequent indications of peritonitis, show that the case is a very serious one. Unless there is a history of preëxisting pyosalpinx, the diagnosis cannot be accurately made before operation. If the trouble is in the right side, the disease is apt to be mistaken for an acute, perforative appendicitis,

but, at any rate, the rapidly progressing abdominal inflammation with general septic signs leaves no alternative, operation being the only treatment which holds out intelligent hope of relief.

Operation. — The fact that the pain began in the pelvic region gives us the only hint as to where the incision ought to be made. The assistants and the instruments are those which are demanded for any abdominal section. (Chapter XI.) General narcosis is, of course, indispensable. If there is vomiting, the stomach should be washed out before beginning the anæsthesia. The bladder should be emptied by catheter, whether the patient can urinate or not. The best incision is in the median line, its upper limit being about an inch below the umbilicus, and its original length dependent upon the thickness of the abdominal wall. The index and middle fingers of one hand should be carried down into the pelvis, where, after locating the fundus uteri, the appendages should be palpated. The affected tube should, if possible, be brought to the surface, but if dense adhesions bind it down in the pelvis, it is better surgery to enlarge the incision sufficiently and, holding the wound apart with blunt retractors, to try to *see* the condition of things. It must be remembered that tubes which have long been distended with inflammatory exudate are often distorted and occupy unusual positions. If there is considerable pus in the pelvis, it should be wiped away with sponges in forceps or in sponge-holders, and the patient's pelvis elevated with the help of a chair and bandages, as shown in Fig. 139. The intestines should be covered with gauze packings, not only to keep them out of the way, but also to prevent the possible spreading of infection. If the tube can be brought up to the wound, the entire mass, including the broad ligament, should be held in a stout clamp, and tied off with a ligature of heavy silk or chromicized catgut. The ovary is, of course, ablated with the tube. A good method of securing the pedicle is to force a stout probe through it, and having passed the ligature through the eye of the instrument, to withdraw it, and cut the ligature in two, tying each half in a firm knot. Then, removing

the clamp, the mouths of the individual vessels must be sought and secured with smaller ligatures of catgut, since there is danger that the thick mass-ligature may slip, even when very carefully applied.

If the technical difficulties are great, and it is impossible to draw the tube out of the pelvis, its entire lumen may be laid open, and the mucous membrane thoroughly curetted with the sharp spoon, so as to destroy as much of this tissue as possible. A gauze packing should be placed firmly against the scraped surface, and its end allowed to protrude from the abdominal wound, being marked by a knot so that it can be easily recognized at the dressing. The intestines should be protected by a sheet of gutta-percha tissue placed next them, and by a gauze packing laid between the gutta-percha and the infected pelvic organs. A few sutures may be put in to close the upper portion of the wound. Adhesive straps over gauze pads should firmly bind the abdominal wound, so that there may be no danger of prolapse of the intestines. If the uterine appendages are apparently normal, and are evidently not the cause of the septic condition, other organs should be explored through the incision, which may be enlarged for the purpose. The vermiform appendix must, in such cases, be borne in mind.

Diffuse peritonitis, if present, must be treated on the principles to be found in Chapter XVI.

After-Treatment. — After the operation the treatment should be modelled on that described under the head of appendicitis, peritonitis, etc., (Chapters XIII. and XVI.) The gauze packings which wall off the intestines, should not be removed until the day after the marked (knotted) gauze has been replaced by a fresh piece. None of the gauze should be disturbed for three or four days, unless symptoms of intestinal obstruction appear. For twelve hours after the protective packings have been removed, the patient must be kept perfectly quiet, using morphine if necessary, so that new adhesions may form where the parts have been disturbed. If a sinus remains after this operation, it may require later surgical treatment.

Strangulation of Pelvic Tumors by Twists of the Pedicle. — Tumors of the ovary are those which are most liable to this accident, though parovarian and other pelvic growths may also become thus strangulated. The symptoms are sudden and increasing pain and tenderness, together with enlargement and increase of resistance on palpation over the tumor. As the return circulation by way of the veins becomes shut off, great congestion of the tumor occurs, and, if the mass is cystic, there is usually hemorrhage into the sac. At the same time, the phenomena of severe shock and, perhaps, of internal bleeding make their appearance, the patient becoming pale, faint, and often nauseated. At first there is no increase of temperature, but the pulse-rate is almost immediately accelerated and arterial tension diminished. When the tumor happens to be a large one, or when its existence was known before the twisting occurred, the diagnosis is comparatively simple. When, however, the patient is seen for the first time during the attack, and the tumor is small, the most careful examination by palpation from without and through the vagina may not render the diagnosis certain, though the necessity for operation will soon be manifest from the progress of the case. Differentiation from appendicitis, when the tumor is in the right side, may be impossible before operation. When the tumor is movable and has a long pedicle, recognition of the condition is not, as a rule, difficult, though a movable kidney with twisted pedicle should be considered as one of the possibilities. The existence of strangury or other symptoms pointing to trouble with the urinary apparatus will cause suspicion of renal implication. As the tumor swells the arterial blood-supply becomes shut off, and gangrene threatens. Adhesions with neighboring structures form, and peritonitis will develop unless something is done for relief.

Operation. — While the occurrence of torsion of the pedicle does not mean that death is absolutely certain without resort to operation, the case is nevertheless so grave, and the chances of recovery without surgical intervention are so slight, that we should do

wrong to treat the condition in any way but by early operative measures.

General anæsthesia will be necessary. The instruments and assistants are the same as those which should be at hand in any important abdominal section. (See page 191.) The bladder must be empty, using the catheter if necessary.

The incision should be made over the tumor if the mass is distinctly toward one side, otherwise in the median line. On opening into the peritoneal cavity serous fluid, often blood-stained, usually escapes, unless the operation is performed very early. The tumor will be recognized as a deep purple or almost black mass, with walls which are friable according to the length of time the constriction has existed. Spots of gangrene may be present, or perforation may already have taken place with infection of the peritoneum and its contents to complicate matters still further. The twisted portion of the pedicle should now be exposed, enlarging the incision sufficiently to permit the work to be done with the help of sight. The pedicle should be transfixed through comparatively healthy tissue at the uterine side of the twist with a blunt instrument, such as the flat end of a large stiff probe, and a doubled piece of stout twisted silk carried through, its loop being then cut so as to form two separate ligatures. These must be very tightly drawn, and tied so firmly that there shall be no danger of slipping. The pedicle may now be cut through, and the tumor ablated. The section should be made far away from the ligature, say at least three-quarters of an inch, so as to still further guard against the accident of the stump's slipping out of the encircling loops. The mouths of the individual vessels may now be sought and secured with additional ligatures of catgut.

If there is no septic exudate, the pelvis may be elevated during this procedure. (Fig. 139.) But if there is danger that septic fluid, which seems to be limited to the pelvis, may by this position find access to the upper portion of the abdomen, all fluid should be carefully mopped away, and the intestines well protected by gauze

packings, before elevating the pelvis. When there is the slightest suspicion of local sepsis in the pelvis, that time is well spent which is used in placing temporary protecting packings between the infected and the uninfected portions of the abdomen. General or diffuse peritonitis is to be treated as described in Chapter XVI.

If it is thought that the wound is perfectly aseptic, and that there has been no infection from the tumor, the abdomen may be closed by suture, using catgut for the peritoneum and chromicized catgut for the fasciæ. The incision in the skin should not be sewn up, but may be drawn together by adhesive strips as soon as granulation has begun. If the patient is very stout, however, one or two silk button-sutures, taken far apart, will prevent excessive gaping of the wound. When it seems probable that the tissues about the stump are not perfectly aseptic, it will be found safer not to close the entire wound in the abdomen, but to leave the lower angle open, and lead a drain of gauze with gutta-percha covering down to the suspected parts, to be withdrawn in two or three days and replaced by a smaller one or by a single strip of gauze.

Dry absorbent gauze, two or three adhesive straps, and an abdominal binder complete the dressing. When the gauze wick has been removed and replaced, a small, wet dressing should be applied over this portion of the wound, the other parts remaining dry as before.

The after-treatment is about the same as that recommended for patients who have been operated upon for any other grave abdominal lesion. (See Chapters XI. to XVI.) Peritoneal irritation may often be relieved by moving the bowels early, as soon, in fact, as the patient has recovered from the shock of the operation and from the effects of the anæsthetic. A succession of small doses of calomel, say a quarter of a grain every ten minutes until two grains have been taken, should be followed by an ounce of the liquid citrate of magnesia every quarter of an hour until six or eight ounces have been administered, provided the bowels give no indication that they will move earlier. Persistent nausea or vomiting would indicate the ad-

visability of causing an evacuation by the use of enemata, deferring sometimes for several days the administration of cathartics by mouth.

Impaction of Tumors in the Pelvis. — This rare accident may become a very serious matter because of pressure of the bowel between the mass and the pelvic wall, with consequent intestinal obstruction. The symptoms of obstruction (page 213), with the presence of a hard, firmly fixed body felt through the vagina, and perhaps through the abdomen as well, should cause suspicion of this complication. When the tumor cannot be disengaged by pressure through the vagina, abdominal section must be performed, and the mass freed from above. The involved intestine should be carefully examined and treated on the principles discussed in Chapters XII. and XV. The tumor should be treated according to circumstances. If there is no necrosis, and the patient's condition seems to forbid prolonging the operation, it should not, at this time, be removed.

Ruptured Ectopic Gestation-Sac. — The rupture of the sac in a case of extrauterine pregnancy is ushered in by an attack of colicky pain, immediately followed by symptoms of severe shock and collapse. Unless the hemorrhage is frightfully severe, the condition of shock remits to a certain extent; but after the remission there is a more or less steady progression of the usual symptoms of concealed hemorrhage, with slight elevation of temperature, increased rapidity and marked feebleness of the pulse, sighing respiration, great and increasing restlessness, pallor, thirst, faintness, and, if the bleeding is unchecked, the termination in death.

There is usually some abdominal distention, with dulness in the flanks. There is pain on palpation over the abdomen, sometimes localized to one or more limited regions, often in the iliac fossæ. Vaginal examination may disclose a resistance or a mass either in the posterior cul-de-sac or to one side of the uterus. The uterus itself is somewhat enlarged and is apt to be tender on bimanual examination. A sanguinolent vaginal discharge may be

present, and there is nearly always a history of irregular catamenia, the menstrual discharge usually having been profuse. The discharge of a cast of the uterus, the decidua coming away in one or more large masses, is quite characteristic. The signs of pregnancy are often present, such as nausea, the enlargement of the mammæ, and disturbances of urination. Sometimes, however, the rupture is the first sign that anything abnormal is in progress. If the hemorrhage is slow, symptoms of peritonitis may develop, obscuring the case still further for the physician who sees the patient the first time.

Treatment.—As in the treatment of hemorrhage elsewhere, the first and most vital indication is to stop the extravasation of blood. This can only be accomplished with certainty by performing abdominal section and attacking the bleeding point itself upon general surgical principles. Here, if ever, speed in preparation and in operation is the quality most to be desired. The surgeon is engaged in a race with death, and on his quickness and skill the patient must build her hopes.

Operation.—The list of instruments is the same as that given under the heading of ruptured pyosalpinx. The assistants, too, should be the same in number; but when the case is so urgent that a few moments may make a vital difference in the probable result, it may be necessary to get on with what would, under ordinary circumstances, be considered insufficient help. Unless the patient is in an almost moribund condition, general anæsthesia will be required. If the pulse is extremely weak, and rapid or irregular, intra-venous saline infusion should be performed simultaneously with the operation or just before it. (Chapter IV., page 64.)

If a distinct mass, resistance, or tumor can be made out by palpation, and the diagnosis of extrauterine gestation is not absolute, the incision should be made in such a locality as to permit of easiest access to the mass. If the diagnosis is clear, however, the incision should be made in the median line, its upper limit being about an inch below the umbilicus. On reaching the peritoneum, this structure will look unusually dark in color, and on

incising it, there will be an escape of blood, both fluid and clotted. If there was abdominal distention, this blood may spurt out with considerable force. The slit in the peritoneum should at once be enlarged to such an extent as will render intra-abdominal manipulation easy, and the hand should be carried down to the uterus, and moved to the right and left seeking the source of the trouble. Much clotted blood will be encountered, but everything should be disregarded until the mass itself has been dealt with. Having found the tumor containing the products of conception, it should at once be drawn up into the wound, and the site of the rupture inspected. The tension on the pedicle often stops the hemorrhage for the time being. The safe and proper treatment for a tumor of this kind is to clamp and ligate the pedicle, removing the entire mass with the appendages of the affected side. The individual vessels should then be ligated with catgut beyond the mass-ligature as an additional precaution. Our attention may now be turned to the presence of the large quantity of blood in the abdominal cavity. It is not necessary in a clean case to remove every bit of extravasated blood. It is usually quite sufficient to clear the larger clots out of the pelvis, using the fingers for the purpose. If, however, there are reasons to suppose that peritonitis is developing, as much as possible should be removed, and the abdominal cavity washed out with copious flushings of normal saline solution poured from a pitcher, the wound being held open by an assistant with blunt retractors which should be drawn apart, and at the same time upward, separating the parietes from the viscera and enlarging the cavity. (Fig. 92.) As much of this solution as will remain should be left in the peritoneal cavity, and the wound should be partly closed by suture, leaving a gutta-percha-covered gauze wick the thickness of a cigar as a drain for the pelvis. If great distention and the signs of peritonitis make more thorough drainage desirable, the wound need not be sutured at all, but may be left open, a pad of gauze lying upon the viscera just beneath the parietal peritoneum

to prevent protrusion. (See page 282.) Adhesive strips and the usual dry absorbent gauze with binder or wide bandage is the proper dressing.

After-Treatment. — The general treatment should be the same as in any case where the abdominal cavity has been opened. (Chapters XI. to XVI.)

A considerable quantity of sanguinolent fluid will be discharged for twenty-four or forty-eight hours, especially in those cases where much saline solution was left in the abdomen. The outer dressings may be changed as often as they become saturated, and, if all goes well, the wound may be dressed, and the drain replaced, at the end of two or three days. If it has been necessary to put in gauze packings, where little or no suture has been practised, the gauze should not be removed until four or five days after the operation, and no attempt made to replace more than a very small fraction of the quantity originally put in. If it should happen that viscera from the free peritoneal cavity are drawn into the wound when the packings are removed, every precaution should be taken that no infection may occur. The viscera should be carefully put back and held in place by a light packing of gauze, and for twenty-four hours after the occurrence the patient should be kept particularly quiet. If the case seems to be going on well, without distention or nausea, the bowels need not be moved for two or three days. If there is distention or troublesome nausea, however, an enema should precede the use of cathartics.

When granulation has begun in wounds which were treated by the open method, the packings, except those which lead to deep recesses, may be omitted and the fasciæ brought together with a few chromicized gut sutures. (See Chapter XIII., page 259.) No suture of the integument should be attempted, however, for a certain degree of suppuration is inevitable, and agglutination of the edges of the cutaneous wound would invite retention.

Cæsarean Section. — Under this heading we understand those operations which effect the delivery of the child through an incision

IMPERATIVE SURGERY

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abdominal parietes. Having exposed the organ throughout the entire length of the wound, light temporary packings of gauze should be laid around it, in order to prevent the intestines from slipping out, and as a dam against the possible entrance of foreign matter into the peritoneal cavity. An assistant should press the abdominal walls against the uterus, surrounding the wound with both hands. The uterus should be inspected for a moment, in order to note whether the placental site is visible. It forms a tumor-like boss somewhat softer on palpation than the rest of the organ, and transmitting a palpable thrill. The uterus is now opened with the scalpel by a vertical incision, preferably avoiding the placental site. Not infrequently the opening is made directly upon the placenta, which may be recognized by the appearance of the tissue which protrudes into the wound. When this has occurred, it is important, in order to avoid unnecessary bleeding, to strip the placenta from the uterine wall with the fingers in all directions. The amnion may then be quickly incised with scissors, and the hand inserted seeking a foetal foot, by which the infant should be extracted. It is essential that the delivery should be accomplished in this manner, whenever the head is in the lower segment of the uterus. If the head is near the fundus, the extraction may be made by any of the presenting parts. When the head is wedged in the pelvis, considerable difficulty may be experienced. It will then be best to hold the foetus by the legs with one hand, while with the other efforts at traction in the axis of the parturient canal are made, rotating or flexing the head by manipulation as may seem necessary to accomplish its disengagement. During this entire procedure the assistant who holds the abdominal walls in contact with the uterus must not relax his hold, and he should carefully guard against the prolapse of any of the viscera. Having delivered the child, the cord should be severed between two artery-forceps, and the infant immediately given in charge of the assistant designated for the purpose. The placenta and membranes should now be removed with the fingers, and the uterine incision

closed by interrupted sutures passing from the serous coat well into the muscle, but not penetrating the mucous membrane. These sutures, of rather fine silk or chromicized catgut, should be numerous enough and close enough together to make strong union and prevent leakage. It is not important that every scrap of placental tissue be removed before suture, since any portions which remain will be cast off by the normal channels.

The uterus contracts after it has been emptied, thus checking the hemorrhage which, though profuse, is not usually alarming, unless the placental site has been cut. The gauze packings which protected the peritoneal cavity from infection may now be removed, and the abdominal wound closed by layer suture, or, if the patient is collapsed, by a single row of stitches passing through the entire thickness of the wall. A dry dressing and a binder should cover the site of the wound.

After-Treatment. — It must be remembered that the patient suffers not only on account of the surgical wound of the abdomen, but that she is in the puerperal state. The treatment should, therefore, be directed toward the attainment of as perfect rest as possible for the first forty-eight hours. The child should not be nursed until the effects of the anæsthetic have fully passed off, and no opiate or other drug which might affect lactation should be administered.

CHAPTER XX

THE EYE AND ORBITAL REGION

Accidental Wounds involving the Orbit.— The orbit contains so much fat and its tissues are so lax that wounds made by undisinfected objects easily give rise to suppuration, the symptoms of which are few and mild until the process has become pretty well advanced. For this reason, it is not good surgery, in any event, to close wounds of this region without ample provision for drainage. The object with which the injury was inflicted should be examined to find out, if possible, whether part of it may not have been broken off and left in the orbit. If it is supposed that a large foreign body lies in the tissues, careful probing should be tried in the hope of locating it. If a small, probably aseptic body, such as a little fragment of stone or a small shot is in the orbit, more harm may result from immediate efforts at extraction than from delay with the possibility that the object may become encysted. The cutaneous portions of the wound should be thoroughly washed and disinfected according to the directions in Chapter II., and its edges then approximated with the finest needle and silk, leaving an opening for the drain which should consist of a little piece of folded or loosely rolled gutta-percha tissue. The sutures, placed very near to the margin of the wound, should be sufficient in number to effect perfect approximation. Even ragged lacerations may thus be closed, for it is a well-known fact that wounds of the face heal kindly. The proper dressing for these wounds is described on page 366.

Wounds of the Conjunctiva.— Rents or wounds of considerable size in the conjunctiva should be closed by suture. Two assist-

ants will be necessary for the operation. It may be performed with the help of cocaine anæsthesia, unless the patient is a child, when general narcosis is advisable. Two fine mousetooth-forceps, a pair of small blunt retractors, fine scissors, and a needle-holder are the instruments required. The finest needles and black silk are recommended. It is best to have the patient in a reclining position either upon a table or sitting in a chair, with the head resting over the back. If general narcosis is employed the patient should, of course, lie upon his back upon a table. The surrounding skin of the face and of the lids should be carefully washed with pads of absorbent cotton and some mild soap, then washed again with three per cent. boric acid solution. The eye, held open with the aid of the blunt retractors, should be irrigated with the same fluid squeezed out of a piece of absorbent cotton. A few drops of a warm three per cent. solution of cocaine hydrochlorate made with distilled water to which has been added salt in the normal proportion, should be instilled into the conjunctival sac, and at the same time a drop put into the sound eye to prevent the disagreeable sensation which occurs when one pupil is dilated and the other is not. While the assistant with the forceps grasps the ocular conjunctiva at a point not too near the cornea and holds the eye in such a position as to bring the wound into view, the operator adjusts the fine black silk sutures.

Any wound extending into the orbit requires the application of a compressory dressing upon the eye. This should consist of a piece of sterile gutta-percha tissue, wet in normal saline solution, placed next to the closed eye, upon this, a piece of absorbent gauze and, covering the whole, a generous pad of dry, absorbent cotton to make compression, the dressing being held in position by a neatly applied firm bandage of gauze, or, still better, of flannel.

After-Treatment of Aseptic Wounds. — Unless considerable shock accompanied the injury, the patient may be allowed to go about the house with the eye bandaged, but the necessity for ocular rest should be impressed upon him, and no reading, writing, or sewing should

be permitted. If there is considerable shock, or if the patient is a child, he should be kept in bed. In forty-eight hours, unless pain or fever makes it necessary earlier, the dressing should be changed. A clean wound will not show any intumescence of the lids or other surrounding parts, though there may be some discoloration due to ecchymosis. The drain may be removed and not replaced, but the compressing dressing should be again applied and kept in position for another twenty-four or forty-eight hours. Five days after the suture the stitches may be removed.

Infected Wounds of the Orbit: Orbital Phlegmon: Abscess. — Suppuration within the orbit may have its origin in an infection after traumatism, it may appear as a process extending from osteomyelitis of one of the orbital bones, or the infection may have come by extension through the lymphatic system from quite a distance, as, for example, from an inflamed tooth. At times, abscess of the orbit comes on from some cause which cannot be discovered even by the most careful search. The symptoms are swelling of the lids, chemosis, protrusion of the globe, gradually progressing immobility of the eye, and the constitutional symptoms which are common in septic infections. If the suppuration is unchecked, the lids begin to redden, the pain in the eye and the head increases, and sight becomes impaired on account of the stretching of the optic nerve. Without treatment, complete and permanent blindness will result. In the absence of distinctly septic phenomena it may be very difficult to diagnose differentially between serous exudation in the orbit and true orbital abscess. If sight becomes impaired, operative treatment should not be delayed, even if it is not certain that pus is present, since the tension within the orbit is the condition which is to be feared. Occasionally, fluctuation becomes evident at some point, showing clearly that we are dealing with an abscess, and, at the same time, indicating the proper point for drainage.

Treatment. — Evacuation and drainage is necessary as soon as the diagnosis of dangerous intra-orbital tension can be made.

General anæsthesia is advisable. One assistant besides the anæsthetist should be present. The list of instruments comprises a sharp, narrow-bladed knife, a pair of small sharp retractors, two artery-forceps, and a slender pair of scissors. The lids and the surrounding skin should be disinfected as described in Chapter III., not forgetting to cover the hair with a wet towel. The patient should lie upon his back, the head turned somewhat toward the healthy side, so as to bring the field of operation uppermost. The conjunctiva should be examined in order to ascertain whether the pus may be pointing through this membrane. If this is so, and the abscess seems to be small, the incision may be made here. But if there is no distinct spot within the conjunctival sac where the pus threatens to break through, or if, even after the incision, it appears that the abscess is large, a counter-opening through the skin is necessary, for the purpose of securing good drainage by tube or a folded piece of gutta-percha tissue.

The opening through the skin is best made over the spot where the pus seems to be nearest to the surface, as shown by œdema, induration, and redness. The direction of the incision should be parallel with the fibres of the orbicularis palpebrarum muscle, and as far from the edge of the lids as may be convenient. By preference, the first opening should be made over the lower orbital edge, in order to take advantage of gravitation in accomplishing the drainage. If it seems wise to make an opening at the outer canthus, the incision should be parallel with the palpebral slit. Where the pus is near the surface, the opening need not be large, but if deep dissection is necessary, the initial incision should be of such length as will permit of careful work in the deeper tissues. The wound being held open with the help of small sharp retractors, all bleeding should be checked with artery-forceps, so that the field may be dry and the work done under the guidance of sight. The appearance of a bead of pus will indicate the spot where a fine pair of scissors may be entered closed, and withdrawn with the blades separated so as to enlarge the opening. Gently

scraping the abscess walls with a small sharp spoon will loosen and remove the more detachable shreds of sloughing tissue. Irrigation, if practised at all, should be performed with caution, assuring ourselves that there is a free exit for the fluid alongside of the irrigating tip or cannula: otherwise the tension within the orbit may be dangerously increased. A small drainage-tube or a piece of properly folded or rolled-up gutta-percha tissue should be placed within the opening and transfixed with a safety-pin to prevent its slipping entirely within the wound. A folded and slit piece of absorbent gauze should be placed beneath the pin so as to prevent metallic contact with the skin, and the whole covered with a bland wet dressing of saline solution. An elastic pad should be placed over the eye so as to insure gentle and uniform pressure, and the whole dressing held in position by a bandage.

After-Treatment. — Daily changes are required, and if the discharge is very profuse, two or more dressings in twenty-four hours should be done. As soon as the discharge becomes scanty and the swelling has disappeared, the drain may be removed, still keeping up the wet dressings for a day or two longer, when, if there are no signs of retention, a simple dry dressing of small size may be applied without pressure, and held in position by a strip of adhesive plaster. At each inspection of the wound the conjunctival sac should be gently washed or irrigated with a warm three per cent. boric acid solution.

Wounds of the Lids. — These require very perfect adaptation with fine silk sutures. A few drops of four per cent. cocaine solution instilled into the wound after thorough disinfection will usually suffice to obtund somewhat the sensation of the tissues, and permit of manipulation without struggling on the part of the patient. If the wounded individual is exceedingly nervous, general narcosis may be necessary, in order to guarantee the possibility of accurate approximation. In children it will usually be required. A pair of scissors, a fine needle-holder, and a small

mousetooth-forceps are the instruments. There should also be fine needles and finest black silk. If the skin alone has been wounded, the edges should be drawn together with fine black silk, while the assistant holds the parts in position with the forceps. When the tarsal cartilage has been divided, two or three sutures, the number depending upon the extent of the wound, should be placed through this structure, taking in the skin at the same time, and then numerous cutaneous sutures should be inserted so that the cicatrix may be as unobtrusive as possible. The usual compressory bandage and pad should cover a piece of sterilized gutta-percha tissue, wet in normal saline solution, and placed next to the eye. It is not necessary to suture the palpebral conjunctiva.

The superficial sutures may be removed in five days, but those passing through the cartilage should be left in place for three or four days longer.

Foreign Bodies Embedded in the Cornea. — Lachrymation, conjunctival injection, photophobia, and recurrent attacks of severe pain, neuralgic in character and affecting the temporal and nasal regions, are the prominent symptoms which indicate the probable presence of a foreign body in the cornea. The usual feeling of irritation which is associated with a foreign body is by no means constantly noted, and as the fragment causing the symptoms may be exceedingly small, it is not infrequently overlooked, and the patient treated for some other condition. A course of mercurial inunctions has even been prescribed, under the mistaken idea that the patient was suffering from syphilitic iritis, when all the symptoms were caused by the presence of two very minute foreign bodies in the cornea. These being removed all signs of disease at once vanished.

A room lighted by a single lamp, or candle carried by an assistant, should be selected for the examination of the eye. While the patient looks upward, the lower lid should be drawn down, and the lower portion of the conjunctival sac inspected, the patient meanwhile moving the eye first to one side, then to the

other. If nothing is seen, the order should be given to look downward keeping *both eyes open*, when the lashes of the upper lid should be grasped with the fingers and thumb, while the middle finger makes gentle pressure upon the lid. In this way the upper lid may be turned so that its conjunctival surface looks forward, and can be closely inspected. If this examination proves



FIG. 148.—Examining the eye with two lenses and a candle.

negative, the patient should look directly forward while the cornea is inspected from all directions, the light being held to the outer side. A lens of about three-inch focal distance will be found useful to magnify the part under examination, while a second lens, used to collect the rays from the candle, may be made to send a pencil of light in various directions through the cornea. (Fig. 148.) Having discovered a foreign body, further search should be made in order to satisfy ourselves that there are no others.

When foreign substances are very deeply embedded, the patient should be treated by palliatives until he can be seen by an ophthalmologist. Those which are comparatively superficial should be removed. Cocaine anæsthesia, except in the case of children, will enable one to perform the little operation painlessly. It is well to have an assistant to manage the illumination. The instruments are a speculum for the lids,¹ a mousetooth or, better, a fixation forceps, and a triangular-pointed probe in the absence of an eye spud. A pointed tenotomy knife may also be found useful. In most instances it will be sufficient to have the patient sit in a chair, his head being hyperextended so that his face looks upward. A few drops of warm, *not hot*, four per cent. cocaine solution should be instilled into the eye from a medicine dropper, the patient meanwhile looking down, and the operator gently retracting the upper lid with his finger. The patient may now close the eye, and a drop of the solution instilled in like manner into the unaffected eye.¹ As soon as the smarting sensation imparted by the drug has disappeared, a few more drops should be put into the eye. In five or six minutes, *not less*, the anæsthesia is sufficient. The eye speculum may now be inserted. (Fig. 22.) This instrument should have been disinfected by boiling it in soda solution, thoroughly rinsing it in distilled water, and then washing in strong alcohol and drying. The conjunctiva near the cornea should be grasped with the fixation-forceps or its substitute, and given in charge of an assistant who shall thus control the movements of the globe. Slight traction should be kept up by the forceps, but under no circumstances must the faintest pressure on the globe be made. (Fig. 149.) The foreign body may be removed by a gentle scraping movement through very small space, using the spud or pointed probe for the purpose. It is essential that the cornea be abraded as little as possible in this

¹ Whenever the eye is to be irrigated or drops instilled, the patient must be informed of the fact, so that he may not flinch and make dangerous muscular pressure upon the globe. An almost perforating wound may, under these conditions, give way, and permit the escape of the ocular contents.

operation. Having removed the foreign body, the eye should be gently irrigated with warm normal salt solution, or three per cent. boric acid, and if considerable abrasion has been necessary, a bandage should be applied for a few hours.



FIG. 149.—Extracting a foreign body from the cornea. An assistant steadies the globe by the fixation-forceps.

After-Treatment. — Next day, the eye must be inspected. There is sometimes a small brown blood-stain at the site of the operation. This should not be mistaken for a foreign body. If there are still some symptoms of irritation, such as injection of the conjunctiva with photophobia, cold applications should be ordered. These are very conveniently made by using little pads of gauze or absorbent cotton, large enough to cover the eye. The wet pads should be laid upon a cake of ice which rests upon a towel in a basin

so that it will not slip about. A dozen such pads may be used, changing them every few moments as they become warm and replacing them upon the ice. Cold applications should be continued for half an hour or an hour at a time.

Wounds of the Globe.—The operative treatment of injuries of this class should always be left to the specialist, even when a delay of forty-eight hours may be unavoidable, since great harm may be very easily done even by the most careful manipulations performed by those who have not had opportunities for perfecting themselves in ophthalmic surgery. The patient should be warned not to close the eye tightly and not to touch the lids or the surrounding parts, for fear that pressure be made which might force out the contents of the globe. If there is already prolapse of the iris or of the transparent media, there must be no attempt at replacement, but the eye should be carefully cleansed by irrigations with warm three per cent. boric acid solution and the closed lids covered with a sterile piece of gutta-percha tissue, over which a gently compressing pad and bandage may be laid. In performing the irrigation, the lids must be held apart by an assistant with a small pair of blunt retractors, and the globe itself should *on no account be touched or pressed upon through the lids*. Great pain may demand the administration of morphine, and, should this become necessary, it is best to give a small quantity of atropine at the same time so that the pupil may not become contracted. The bowels should not be permitted to move, for fear that through straining further injury to the eye may occur.

CHAPTER XXI

THE EAR AND MASTOID REGION

Acute Suppurative Median Otitis.—Empyema of the tympanic cavity, when acute, is usually due to the extension of an inflammatory process from the pharynx or post-nasal region. It frequently occurs in children who suffer from adenoid vegetations of the naso-pharynx. The disease is accompanied by more or less deafness, with pain of a peculiarly agonizing throbbing character, increased on any exertion, especially blowing the nose. Drawing the external ear upward and backward by taking hold of the helix also increases the pain. There is loss of appetite and great restlessness, while fever and other general disturbances accompany the disease. Œdema of the external auditory meatus is not often marked. Tenderness on pressure over the mastoid process is frequent. Often there is general headache besides the earache already mentioned. On inspecting the drum with the aid of a head reflector and speculum (Fig. 150), while drawing the ear slightly upward and backward to straighten the canal, the membrane will be found highly congested and bulging, the normal reflex being lost. Should the drum membrane be invisible because of an accumulation of cerumen, a few instillations of peroxide of hydrogen solution of the usual strength (fifteen volumes), followed by a gentle syringing with water at a temperature of 108° F. will soon remove the wax and render the tympanum visible. The canal should then be wiped out with a bit of cotton wound upon a fine applicator, using the aural speculum through which to work.



FIG. 150.— Ear speculum.

Treatment.— If there is considerable pain on pressure over the mastoid process, together with the symptoms and appearances just described, or if in the absence of mastoid tenderness constitutional symptoms are marked, the drum should be punctured. The little operation may be preceded by the instillation of a few drops of a ten per cent. cocaine solution, which must be warm. An assist-



FIG. 151.— Angular lance.

ant should support the patient's head, especially if the patient is a child. The in-

struments necessary are an ear speculum and an angular lance. (Fig. 151.) The location of the incision should be in the upper anterior quadrant of the drum membrane. The knife must be very carefully "aimed," its point held for an instant close to the membrane, and then rather quickly plunged through the drum head and carried downward into the lower anterior quadrant. This incision is to be preferred to mere puncture, which is likely to close too soon. The pain is momentary, but severe. Pus, often offensive, usually escapes at once with quite a gush, and there is relief. After the operation the ear should be gently irrigated every two hours with warm three per cent. boric acid solution. When such irrigation is intrusted to the nurse, warning must be given that though the ear may be drawn upward and backward the nozzle of the syringe or irrigator must on no account enter the canal. A fountain syringe should be preferred in non-medical hands to the usual piston syringe. A very light packing of sterile absorbent gauze should be laid in the meatus and changed every hour or two according to the discharge.

Acute Suppuration in the Mastoid Process.— This condition may appear as a complication with acute median otitis, or it may come on after months or even years of chronic middle-ear inflammation. Not uncommonly there is a history of long-continued otorrhœa, the complication occurring on the stoppage of the dis-

charge. Mastoiditis is accompanied by the signs of general septic absorption, together with certain local indications. Pain on pressure or on percussion over the bone is an invariable observation. Edema is usually, but not always, present. Redness of the skin is a very late sign, though the counter-irritant applications which the patients are in the habit of making before seeking medical advice often cause discoloration. If the case is one which has been long neglected, there may be signs of chronic sepsis with metastatic abscesses, and even such signs of meningeal irritation as dilatation, irregularity and sluggishness of the pupils, stupor, disturbances in the respiratory rhythm, retraction of the head, and great irregularity of the pulse both as to its rate and power. Stiffness of the neck may also be occasioned by involvement of the sterno-mastoid muscle, while the occurrence of inflamed lymph-nodes along the neck or behind the angle of the jaw is sometimes responsible both for apparent rigidity and for tenderness on pressure. Great headache and vomiting are cerebral symptoms of importance.

Treatment. — As soon as mastoid implication is diagnosed with a fair degree of certainty, operation is the only treatment which holds out a reasonable hope of recovery, while it can hardly, if ever, do the harm which may arise from delay, even if the case is not one of urgency.

The patient should be prepared in the usual manner (see Chapter III.); the hair should be removed by shaving the entire region which is likely to be touched by hand or instrument during the operation, *i.e.* over the area bounded by the line of the parietal eminence to the occiput. The ear should be cleansed as well as possible by irrigation.

At least two assistants in addition to the anæsthetist should be present. The instruments are a scalpel, a pair of sharp and a pair of blunt retractors, eight or ten artery-forceps, curved scissors, probes, a periosteal elevator or raspator, an anatomical-forceps, a small sharp-spoon, a dressing-forceps, a mallet, an aspirating syringe in good working order, and one small and one

medium-sized gouge. Since it is possible that thrombosis of the lateral sinus may complicate the case, instruments for both operations should be ready, besides the apparatus for intra-venous saline infusion. (Chapter IV.) A rongeur-forceps will prove very useful, but the operation may be safely undertaken without this instrument. Stout, curved needles and needle-holder, sutures, ligatures, sponges, and dressings should be ready. The patient's hair should be so arranged that it shall not be in the way, and everything except the face and field of operation covered with a wet towel, the external auditory meatus being plugged with gauze or cotton. In female patients the hair should be braided and pinned in a coil on the top of the head. Earrings must be removed.

After narcotization, the head should be laid over upon the healthy side, and all pillows except a thin cushion under the shoulders removed. A slightly curved incision, its convexity backward, should be made from about half an inch below the tip of the mastoid process to a point as high as the top of the auricle. Bleeding from the scalp may be controlled temporarily by artery-forceps which compress its entire thickness. The posterior auricular artery or one of its branches is usually cut and should be secured and ligated at once. The periosteum should be peeled off with the elevator or the raspator, and held away with the same retractors which hold the scalp, the ear being drawn forward and held down by the handle of the anterior retractor. A ridge of bone will now be seen at the level of the upper portion of the auditory meatus, running backward and slightly upward for about half or three-quarters of an inch. (Fig. 152.) This is called the suprameatal spine, and marks the location of the lateral sinus. It can often be felt with the finger more distinctly than it can be seen.

With the larger of the gouges, the bone should be chiselled away, from the suprameatal spine downward toward the apex of the mastoid, the gouge being held at a slight angle with the cranial surface in order to remove the bone in thin layers. The

chips should be taken away by an assistant with the dressing-forceps and the sponge, so as to leave the field of operation clear.

There is some oozing from the bone which may usually be checked by means of gauze compression, but occasionally a vessel of larger size coming out of the bone may cause troublesome hemorrhage. If the foramen is large enough, a thin strand of catgut may be pushed into it, which will cause coagulation. Another effective way to stop hemorrhage from these vessels is to insert a sharp-pointed narrow-bladed knife, such as a

sharp tenotome, into the foramen and twist it about in such a manner as to peel the vessel from its bony casing, when it will retract and its walls will curl inward, the hemorrhage ceasing. If there is



FIG. 152. — Operation for mastoiditis. The suprameatal spine is not well developed in this case, a rounded elevation taking its place. The spine itself could be slightly made out with the finger.

beeswax at hand, a little of it may be warmed and worked or kneaded between the fingers until it has become quite plastic, when it may be rubbed in at the bleeding point, entering and plugging the orifices in the bone. Wax in order to be aseptic should be prepared before the operation. As the mastoid cells are opened, pus usually wells out, but the chiselling should proceed until the bone as far as or even including its tip has been cut through to the inner layer, which can, as a rule, be distinguished by its dense appearance. No harm, however, but possibly good, will result from cutting the mastoid through at one point so as to expose the soft tissues beneath, — the dura and the wall of the sinus. Occasionally one sees cases where there is no free pus but where the cells are filled with granulation tissue or even with dense bone, the entire mastoid process having undergone eburnation. Great caution should be observed all through the operation that no harm may be done to the brain or the sinus. If the chisel is held very nearly parallel to the bone, this is most improbable, but in order to guard still further against accident, it is well to work with the sharp spoon as much as possible after the mastoid itself has been actually opened. It will be wise for one not accustomed to this kind of work to be satisfied with relieving pressure and draining the septic cavities without attempting anything too radical in the way of a cure. If the case is one of simple mastoiditis, the threatened danger to life will have been done away with, in all probability, by the mere opening of the cells.

The entire wound should now be packed with gauze and covered with a dry, aseptic dressing held in position by a bandage. There should be plenty of cotton about the throat in order to avoid embarrassment of respiration, since the patient will probably still be narcotized.

After-Treatment. — After this operation, morphine is absolutely necessary for the first twenty-four or even forty-eight hours. In three days the dressing should be changed, and until granulation has begun wet dressings will be found soothing and conducive to

drainage. The wound fills with granulations which cover the bone and are themselves gradually covered by epithelium. A depressed scar results. Fistulæ which may follow will require later operative treatment.

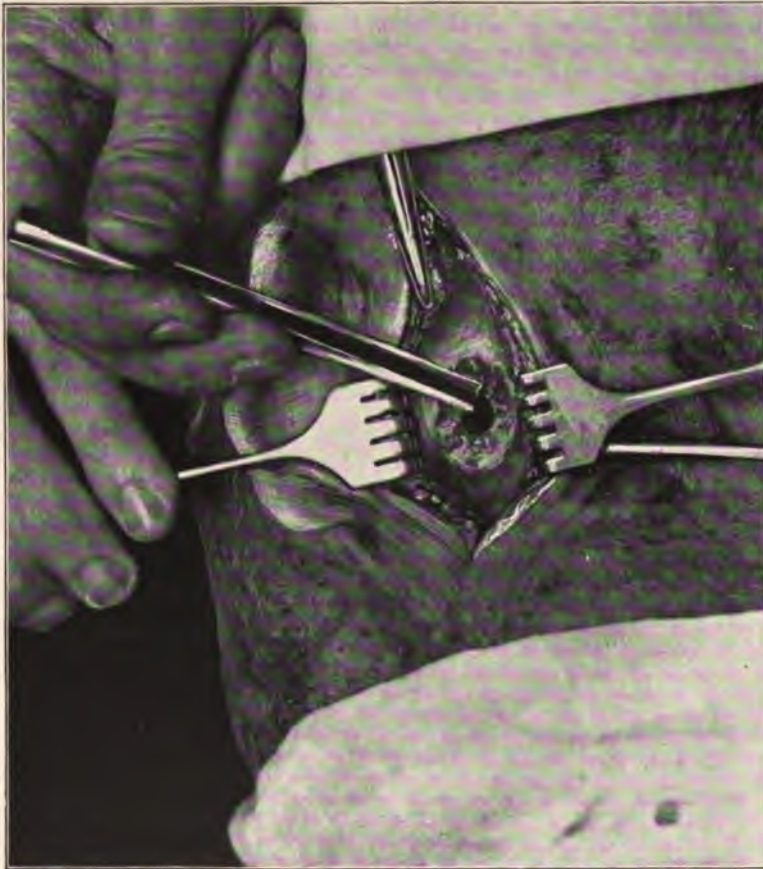


FIG. 153.—The mastoid process opened. A rather large cavity is exposed, probably the antrum.

Unless the septic manifestations quickly subside, the wound should be most carefully examined to detect retention or other signs of extending trouble. If nothing can be found locally, a full and painstaking examination of the entire individual should leave

no possibility of our having overlooked any local or general cause of the continued sepsis.

Thrombosis of the Lateral Sinus. — This very grave condition is nearly always secondary to disease of the mastoid process. We have the signs of mastoiditis with the chills, sweating, and great variations of temperature so common in violent sepsis. There is often distinct pain on pressure in the upper part of the posterior triangle of the neck, due usually to phlebitis, though tender lymph-nodes may also be encountered here. There may be œdema of the occipital region, a sign which, together with the others, is of value. The character of the sepsis is worth noting. The patient has a dull typhoidal expression, with a tendency toward loss of consciousness, which may proceed to deep coma with irregularities of respiration, immovably dilated pupils, irregular, weak, rapid, and often intermittent pulse, and a general progression of the evil symptoms until death occurs. As the disease develops, septic matter becomes disseminated from the thrombus through the system by way of the blood current. Metastatic abscesses due to emboli are then found in the lungs, the spleen, the kidneys, and other organs.

Treatment. — It is rare that sinus thrombosis occurs without the presence of mastoiditis, so the operation for the latter disease will usually precede the steps necessary for the exposure of the sinus and the removal of its septic contents. When the diagnosis is fairly certain, the incision should be extended along the anterior border of the sterno-mastoid muscle as far as the clavicle, the patient's shoulders being placed on a cushion in order to render the region more accessible and to put the skin upon the stretch. (Fig. 64.) The border of the muscle being clearly exposed by incising the platysma, it should be drawn backward with a blunt retractor and the dissection carefully proceeded with, according to the directions given in Chapter IV., palpating along the border of the muscle from time to time so as to feel the carotid artery and recognize it by its pulsations. The external jugular vein is severed by this incision.

It lies just beneath the skin, crossing diagonally the middle third of the sterno-cleido-mastoid muscle. The deep jugular vein will be found just behind and to the outer side of the common carotid, and when in a normal condition is easily recognized by its bluish hue. The head of the patient should be occasionally raised so as slightly to flex the neck, thus permitting the vein to fill and become more easily visible. When the tissues of the neck are stretched, the vessel may become empty and flattened, so that it resembles a piece of fascia. If there is thrombosis of the sinus, the jugular will usually be found but partly filled or, in case the clot extends rather far down, it may be entirely empty and not easy to recognize. Besides, when the disease has involved the vein in the inflammatory process, its walls may have become much thickened and adherent to the surrounding tissues. The part near the clavicle is apt to be the most normal in appearance. Holding this portion of the jugular carefully with an anatomical-forceps, — not a mousetooth-forceps, which might lacerate its walls, — a flat probe may be slowly and cautiously pushed between vein and artery, at the same time being sure not to include the pneumogastric nerve, which lies between and behind these vessels. A strong but thin piece of catgut should be made fast to the probe, drawn around the vein and tied securely with a surgeon's knot. The precaution of tying the jugular is intended to prevent the entrance of septic matter which may be loosened from the thrombus during the chiselling and other manipulation. Laying a temporary packing upon the wound of the neck, a two-inch incision straight backward from the middle of the original wound of the mastoid region should be made, the scalp being clamped as before to check hemorrhage. After peeling away the pericranium, the whole wound should be held apart with sharp retractors, and the bone chiselled away as far as the inner table, beginning at the opening in the mastoid and working backward. It is best not to remove any portion of the inner table until it has been exposed over an area about an inch in length and three-quarters of an inch in width.

The cavity of the cranium may now be opened with the chisel, tapping the obliquely held instrument with extremely light blows of the mallet. The shell of bone is very thin and brittle, although hard, and careless force is liable to cause a fracture with injury to the sinus or even to the brain itself. Having cut through the inner table at one point, the opening may be easily and safely enlarged with the sharp spoon, each little chip as it is loosened being removed with forceps. There must be no undue haste at this stage of the operation, but the work should go on steadily and carefully. The sinus is normally bluish in color, but in disease it looks grayish, and is sometimes surrounded by fluid, or even by solid lymph or granulation tissue. The thrombosed vessel does not move with respiration, and its walls are quiet except for possible motion transmitted from the brain. The aspirating needle should now be plunged into the sinus, at that point which appears most diseased. Unless the syringe at once fills with fluid blood, thrombosis is present. Because of the partial breaking down of the clot, clear serous fluid, pus, or dark grumous material may appear. The tap may be perfectly "dry," nothing being drawn into the syringe, although it is certain that the point of the needle is within the lumen of the vessel. Before being satisfied with this finding, it is well to test the needle and syringe once more, so that there may be no source of error on that score. Being sure that there is thrombosis, the cranial wound should once more be packed and attention given to the jugular. Removing the temporary packings, the vessel should be well exposed with the aid of blunt retractors, and a second ligature passed around it half an inch or more above the first one. The vein should be divided between the two ligatures, and carefully dissected up, until the facial vein is reached. This vessel enters the jugular at about the level of the hyoid bone, its direction being from the anterior border of the insertion of the masseter muscle. It should be ligated between two artery-forceps, and cut away from the jugular, which may now

be opened. The jugular will be found empty or nearly so, unless the thrombosis has proceeded to such an extent that septic clot is encountered. When there is phlebitis the walls of the vessel may be found so thick that the lumen stands open like that of a large artery. The packing should now be removed from the cranial wound, and the sinus opened at its anterior portion by an incision parallel to the axis of the vessel. While an assistant stands ready with a gauze tampon, to be used in the event of a serious hemorrhage, the operator may gently insert a very small sharp spoon or a grooved director into the anterior portion of the thrombosed sinus, then into the posterior portion toward the occiput. If the confines of the thrombus are not reached in this way, more bone may be removed posteriorly so as to expose more of the sinus, the spoon or director being then again used. A gush of blood indicates that the free portion of the vessel has been reached, and after from two to four seconds of bleeding the gauze tampon should be used to check further hemorrhage. Irrigation with warm normal saline solution may now be attempted through the anterior portion of the sinus, in order to determine by the escape of the fluid through the opening in the jugular that enough of the thrombus has been removed to permit of drainage. If the fluid will not escape at the opening in the jugular, the probe should be inserted from below, the opening in the vein being enlarged upward, and more of the vessel dissected out. If the irrigating fluid runs through freely, it is not necessary to free the vein so high as to injure the main trunk of the facial nerve. The operation, so far as the accomplishment of drainage is concerned, may now be regarded as complete. A few sutures should be put in to close the lower portion of the cervical and the posterior portion of the transverse incision, but the remainder must be treated by the open method, the large wound being packed and dressed "dry." If much blood has been lost, it will, perhaps, be necessary to perform saline infusion. A very thick pad of gauze should completely encircle the neck, in order to avoid unequal compression.

After-Treatment. — This should be directed against the sepsis, following the principles laid down in Chapter V. The wound should be permitted to heal by granulation, wet dressings supplanting the dry one forty-eight hours after the operation, and being changed daily until the wound is perfectly healthy. Constant watch for secondary abscesses should be kept, and involvement of other organs on account of the sepsis or septic emboli must be treated as the necessity arises. The danger of septic pulmonary embolism and infarction is a frequent one, but, though usually fatal, it is not necessarily so. The chief indication is to keep up the patient's strength, and treat each complication as it makes its appearance.

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